INTRODUCTION

LOAD FORECAST

1981-95

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

PREPARED BY:

FORECAST SECTION/
STRATEGIC DEVELOPMENT

JUNE, 1981

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EXECUTIVE SUMMARY

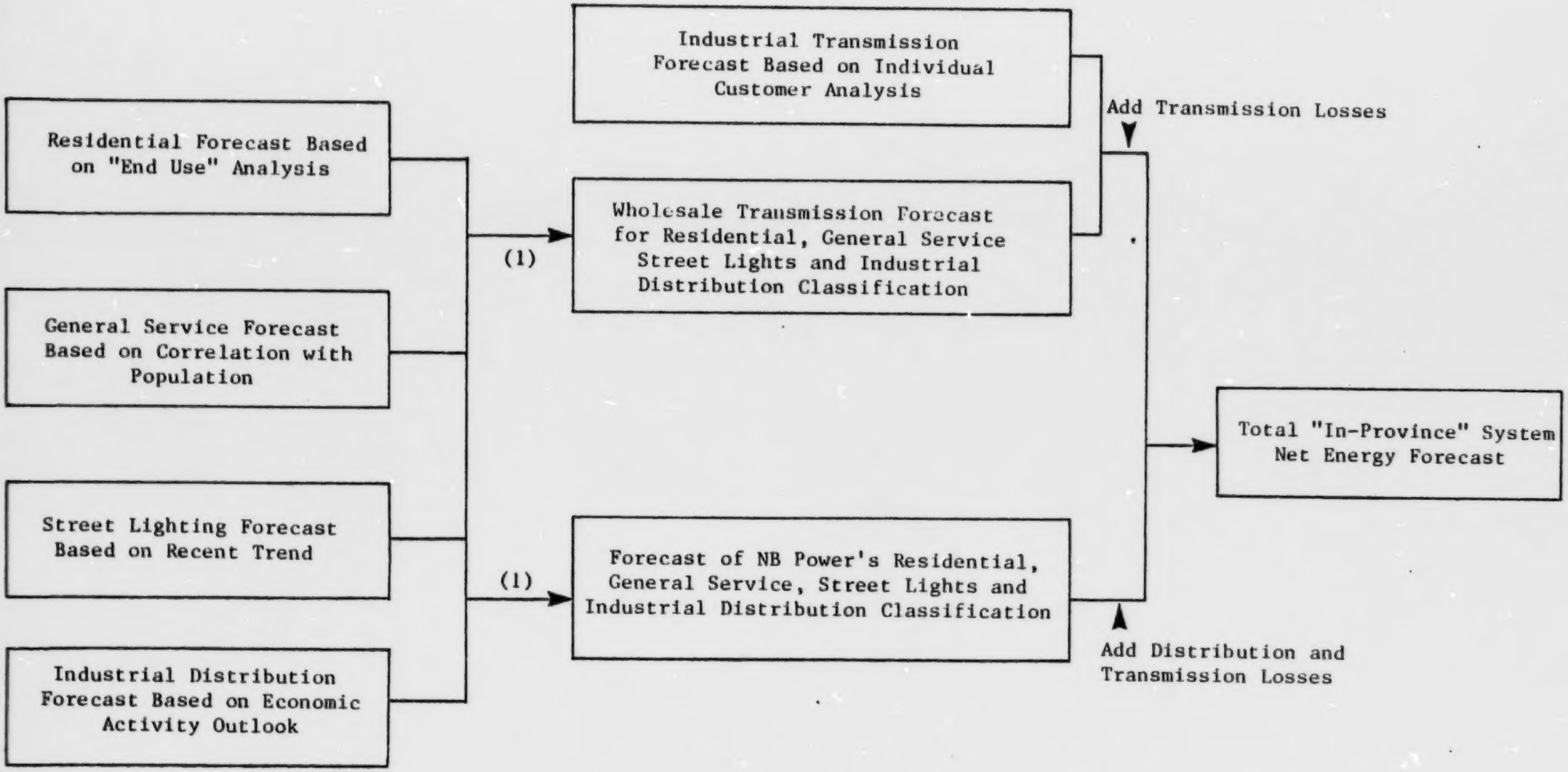
This document presents a forecast of the demand for electrical energy by the customers of The New Brunswick Electric Power Commission for the period 1981 through 1995. It is intended to provide a basis for the financial and system planning processes of the Commission.

The annual energy requirements are forecast for distinct customer classes: Residential, General Service, Industrial Distribution, Industrial Transmission, Street Lights and Wholesale for Resale. Transmission and Distribution losses are also accounted for. To facilitate the planning functions, the annual energy forecast has been converted to monthly energy and peak hourly demand values. This conversion is done on the basis of historical trends.

The yearly forecast up to 1990 is based on a detailed analysis of key factors. The annual growth rate for each customer classification in the fiscal year 1989-90 is then used to project the results from 1990 to 1995.

Forecast methodology for each customer classification is outlined in Flowchart I and discussed in succeeding sections of this report. Key input variables are identified and any significant changes in their magnitude since the November, 1979 load forecast are also indicated in this report.

FLOWCHART I


Industrial Transmission Forecast Based on Individual Customer Analysis
Residential Forecast Based on "End Use" Analysis
Add Transmission Losses
Wholesale Transmission Forecast for Residential, General Service Street Lights and Industrial Distribution Classification
(1)
General Service Forecast Based on Correlation with Population
Total "In-Province" System Net Energy Forecast
Street Lighting Forecast Based on Recent Trend
(1)
Forecast of NB Power's Residential, General Service, Street Lights and Industrial Distribution Classification
Industrial Distribution Forecast Based on Economic Activity Outlook
Add Distribution and Transmission Losses

(1) The sales forecast for each of the four classifications is allocated- on the basis of historical ratios - to determine the Wholesale portion and NB Power's portion.

IN-PROVINCE FORECAST METHODOLOGY

SUMMARY OF RESULTS

Use of electrical energy by the Commission's customers is expected to grow at a compound rate of 3.5% from 1980/81 to 1990/91, which can be compared to the 4.3% rate forecast in 1979.

The compound growth rate for peak hourly demand for the next ten (10) years - 1980/81 to 1990/91 - is forecast to be 3.7%. This can be compared to the 4.4% rate forecast in 1979.

The expected reduction in peak demand and energy forecast can be attributed mainly to: (1) use of wood for space heating, (2) conservation, (3) availability of natural gas in New Brunswick, (4) lower population forecast.

Principle results of this 1981 load forecast are shown in Table I. A comparison of the 1979 and 1981 energy and peak hourly demand forecasts is shown in Table II. The system net energy (total sales within the province and associated losses) and peak hourly demand for the 1979 and 1981 load forecasts are also compared in Graph I. The forecasted energy sales are basically the same in the two forecasts until 1985.

TABLE I

PRINCIPLE RESULTS OF THE 1981 LOAD FORECAST

	1980-81 Actual	1990-91 Forecast	Compound Annual Growth Rate(%) 1981 to 1991
Residential Sales (GWh)	2,057	2,844	3.3
Average Annual Use per Household (kWh)	10,415	12,168	1.6
General Service Sales (GWh)	1,165	1,553	2.9
Industrial Distribution Sales (GWh)	329	539	5.0
Industrial Transmission Sales (GWh)	3,301	4,872	4.0
Street Lights Sales (GWh)	50	68	3.1
Wholesale for Resale (GWh)	640	831	2.6
Total Sales (GWh)	7,564	10,707	3.5
System Net Energy (GWh)	8,311	11,754	3.5
Annual Load Factor (%)	62.8	61.6	-0.2
Peak Hourly Demand (MW)	1,502	2,160	3.7

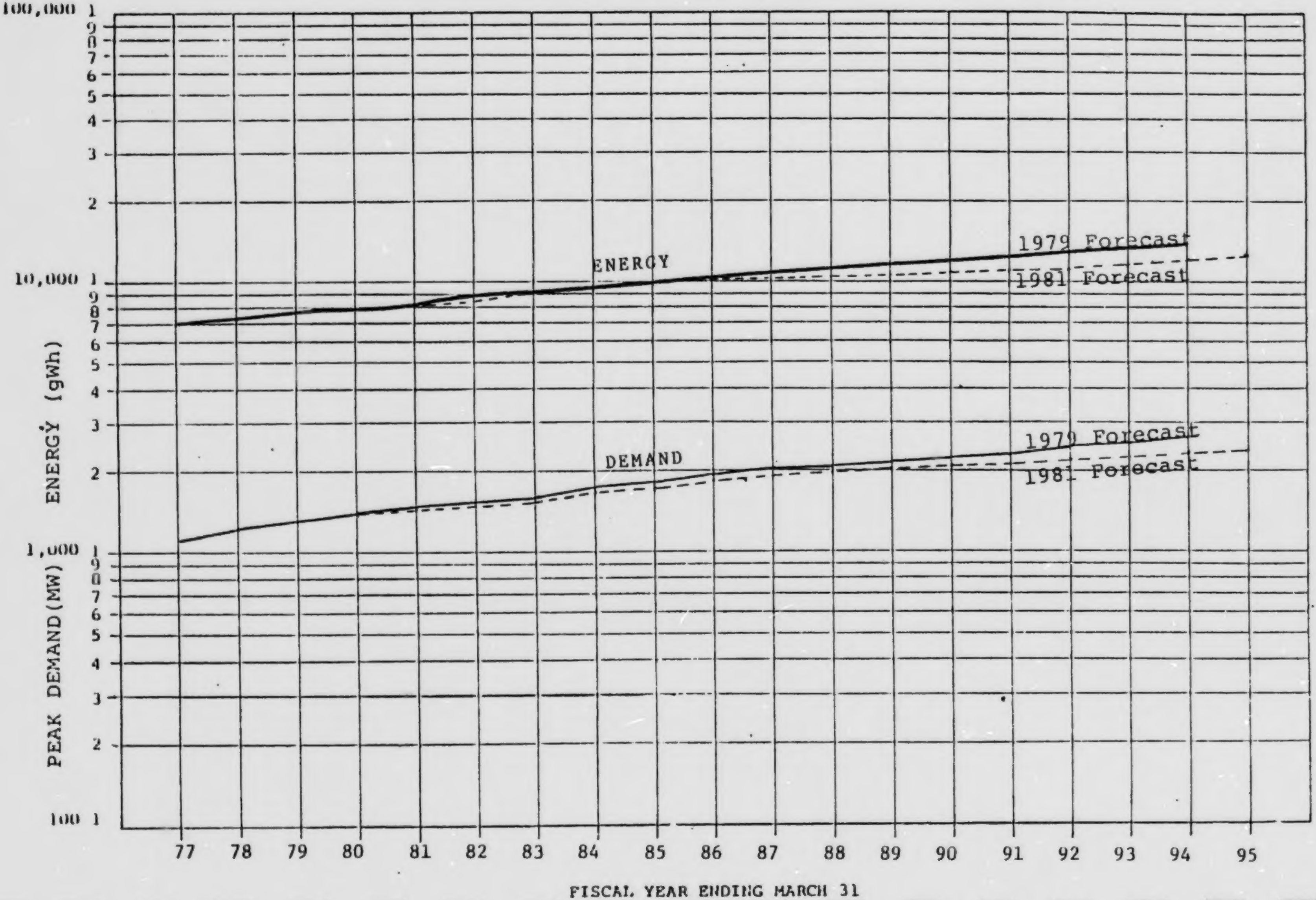
TABLE II

COMPARISON OF 1979 AND 1981 LOAD FORECAST

	System Net Energy (GWh)		Peak Hourly Demand (MW)	
Fiscal Year	1979 Forecast	1981 Forecast	1979 Forecast	1981 Forecast
1980-81	8,407	8,311	1,553	1,502
1981-82	8,922	8,732	1,642	1,591
1982-83	9,310	9,391	1,724	1,690
1983-84	9,740	9,724	1,808	1,754
1984-85	10,101	10,041	1,877	1,815
1985-86	10,524	10,333	1,958	1,872
1986-87	10,944	10,618	2,039	1,930
1987-88	11,374	10,906	2,123	1,988
1988-89	11,817	11,184	2,209	2,045
1989-90	12,276	11,468	2,299	2,102
1990-91	12,751	11,754	2,392	2,160
10 yr. Growth Rate (%/yr.)	4.3	3.5	4.4	3.7
1991-92	13,238	12,043	2,488	2,220
1992-93	13,744	12,339	2,588	2,281
1993-94	14,267	12,639	2,692	2,343
1994-95	N/A	12,940	N/A	2,406
Total Period Growth Rate (%/yr.)	4.2	3.2	4.3	3.4

GRAPH I

COMPARISON OF ENERGY AND PEAK DEMAND FORECASTS: 1979 TO 1981



INTRODUCTION

The New Brunswick Electric Power Commission's forecast of energy sales is prepared for six distinct customer classifications. These classifications are:

1) Residential - includes households, farms, churches and seasonal customers.

2) General Service - includes retail outlets, schools, hospitals, offices, motels/hotels, service stations.

3) Industrial Distribution - includes wood related processing (sawmills), metal fabricating, pumping stations, fish processing.

4) Street Lights - includes regular street lights, dusk to dawn lights, railroad crossing signals, signal lights.

5) Wholesale for Resale - includes all of the above classifications as supplied to the cities of Saint John and Edmundston.

6) Industrial Transmission - includes pulp and paper industry, mining, processing, refining.

Two principal reasons for preparing a separate forecast for each of the above classifications are: (i) the requirements of each customer classification are affected to a different degree by the various economic, demographic and other factors which influence electrical energy sales, (ii) the forecast of each customer classification is needed for financial and system planning.

The succeeding sections of this document include a brief historical perspective, the forecast methodology, the principle results and their comparison to the previous forecast for each of the six customer classifications. In addition the report includes sections on total province system net energy and a monthly breakdown of the annual energy forecast.

RESIDENTIAL CLASSIFICATION

The increased use of electric space and water heating in the early 70's resulted in a rapid growth of the electrical energy sales to the Commission's residential customers - an average annual rate of 11.7% between 1969/70 and 1979/80. As a result NB Power's residential share of the total provincial electrical energy sales has increased from 19.5% to 28.5% in the last decade. However, the average annual growth rate since March 31, 1977 has been closer to three percent (3%) per year.

The main reason for this decline in growth rate since 1977 is considered to be the resurgence of wood as a space heating fuel, especially as a back-up fuel in electrically heated homes[1].

Many variables - some of which are interdependent - influence the electrical needs of the residential customers. The key variables are:

- growth rate for population over fifteen (15) which in turn is dependent on mortality and migration rates;

- average number of people in a household;

- ownership and usage of electrical appliances, particularly space and water heating equipment;

- the relative price and availability of alternate energy sources;

- the current trends and potential for conservation;

- policies of the Federal and/or Provincial governments which encourage, through grants or incentives, the use of one energy source over another to attain a desired energy balance;

- technological developments.

This forecast has attempted to assess the current and expected impact of the above variables.

FORECAST METHODOLOGY:

The Residential classification energy forecast is divided into two groups: seasonal and regular (year-round). The regular customers account for nearly 99% of the sales to this classification. The forecast for this group was prepared by applying the "end use analysis" approach. The procedure identifies the quantity of electricity used by each consuming source, e.g., space heating, water heater, refrigerator, freezer, stove. Three major components of this model are:

1) housing stock (number and type of housing units)

2) appliance saturation (number and type of electrical appliances in use per household)

3) appliance use (the average amount of electricity required to operate each major household appliance)

The Residential forecast energy for regular accounts was determined as:

ENERGY = HOUSING STOCK x APPLIANCE SATURATION
x APPLIANCE USE

The forecast of seasonal customer requirements is based on extrapolation of total historical consumption for this group.

The major components of the forecast model - for the regular residential customers - are discussed below.

1) Housing Stock:

Based on increases in the number of residential accounts in New Brunswick it was estimated that the number of households grew at an average annual rate of 3.73 percent per year over the last eight years. The population of New Brunswick increased at an annual rate of 1.25% during the same time span[2]. This threefold increase in households as compared to the population was due to the decreasing household size - a drop from 4.5 to 3.5 persons per household between 1966 and 1976[3]. However, recent data indicates a relative stability of the household size[4] - caused partially by the prevailing economic conditions.

Persons per household and the provincial population are thus the two key variables which will influence the future housing stock. Future population levels depend on:

a) the fertility rate (births per 100 of female population between 15 and 44);

b) the mortality rate (deaths per 1000 people);

c) migration rate (the number of people migrating into or out of the province).

Fertility and migration rates are the more significant - and difficult to project - components of a population projection. Both factors are influenced by social and economic conditions. The difficulty in forecasting fertility rates is overcome - for our purposes - by basing household formation projections on population over fifteen years of age. (people already born and expected to head households within the forecast period).

The number of households were thus projected on the basis of population over fifteen (see Appendix A) and the household headship rate[5] (Appendix B) for people in this age group. The historical estimates and projections of population over fifteen and households are shown in Table III.

TABLE III

		Col. (1)	Col. (2)	Col.(1) x Col.(2) / 100
Fiscal Year		Population Over Age 15	Headship Rate* Estimates	Number of Households
1971-72	Actual	434,200	37.556	163,068
1972-73		442,800	38.505	170,499
1973-74		452,100	39.629	179,163
1974-75		462,200	40.648	187,875
1975-76		476,100	40.905	194,749
1976-77		488,200	41.573	202,959
1977-78		500,400	41.845	209,392
1978-79		511,800	41.864	214,260
1979-80		521,700	41.881	218,493
1980-81		530,400	41.891	222,190
1981-82	Forecast	538,900	42.007	226,376
1982-83		546,000	42.088	229,800
1983-84		552,600	42.160	232,976
1984-85		558,800	42.225	235,925
1985-86		565,300	42.284	239,008
1986-87		571,700	42.339	242,000
1987-88		577,900	42.390	244,971
1988-89		583,400	42.437	247,536
1989-90		588,600	42.481	250,037
1990-91		593,800	42.523	252,483
1991-92		598,900	42.562	254,891
1992-93		603,700	42.599	257,115
1993-94		608,800	42.634	259,531
1994-95		613,900	42.667	261,889

* Percentage of people over fifteen (15) years of age who are the head of a household.

2) Appliance Stock:

The amount of electricity utilized by a household depends on the type and number of electrical appliances in use. The estimation of current and future saturation levels - percentage of households having particular appliances - is therefore an important step in the residential forecast.

Estimates of current saturation levels of appliances were obtained from the 1979 Appliance Saturation Survey[6]. Highlights of the survey are given in Appendix C. The saturation levels for all major appliances - excluding electric space and water heating - were projected on the basis of historical trends. Projections in our 1979 Load Forecast, which were based on trend analysis of saturation survey data up to 1975, were generally validated by the results of the 1979 saturation survey.

Electric space and water heating account for more than one-half of the current total residential energy consumption. The saturation levels for these two applications have risen rapidly during the last decade - a change from 2.1% to 22.4% for space heating and from 36.9% to 64.8% for water heating between 1971 and 1979. The future growth for electric space and water heating is expected to result from their penetration into new construction and due to conversion of existing homes from alternate fuels - mainly oil - to electricity.

The penetration of electric space and water heating into new residential construction is estimated at 60% and 80% respectively.

These penetration levels are forecast to drop upon the availability of natural gas in New Brunswick. The anticipated effect of natural gas on the residential load forecast is based on the following basic considerations:

1) Natural gas will have its effects felt by the fiscal year 1983/84.

2) Natural gas will be available to 50% of the residential customers within the province.

3) In new residential construction - within the gas service area - 75% of the customers will choose natural gas for space heating and 60% of this group will install gas water heaters, i.e., gas will capture 37.5% of space heating and 30% of the water heating market in the new residential construction within the province.

4) Electricity will capture 60% of the space heating and 80% of water heating in the new residential market outside of the gas service area and the same percentage of the non-gas homes within the gas service area.

5) No existing electric space heating customer will convert to natural gas.

The saturation levels of electric space and water heating are also likely to be affected by existing homes switching from oil to electricity as a primary heating fuel. The conversions from oil to electric space heating are expected due to: (1) federal government grant (maximum of $800) for substitution of oil by alternate fuels including electricity and (2) improved economics of electric heating in relation to oil. The effects of conversion on space and water heating are derived in Appendix D.

The saturation levels of space and water heating were projected (Table IV) based on the above considerations related to penetration rates, natural gas and conversions.

TABLE IV

PROJECTIONS OF APPLIANCE SATURATION LEVELS*

Type of Appliance	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Electric Heating	22.6	24.4	26.3	27.3	28.4	29.3	30.3	31.4	32.4	33.5
Electric Water Heater	64.5	65.0	66.2	66.4	66.4	66.3	66.3	66.2	65.9	65.8
Electric Range	85.9	87.0	88.1	89.0	89.9	90.7	91.5	92.2	92.9	93.6
Refrigerator	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5	99.5
Freezer	55.0	56.2	57.3	58.3	59.2	60.1	60.9	61.6	62.3	63.0
Clothes Washer (Auto & Wringer)	85.8	85.7	85.6	85.4	85.3	85.2	85.1	85.0	84.9	84.8
Electric Clothes Dryer	71.6	72.8	73.9	75.0	75.6	76.1	76.6	77.1	77.6	78.1
Television (B & W & Color)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Air-conditioner	6.2	6.6	7.1	7.6	8.1	8.6	9.2	9.8	10.5	11.2
Dishwasher	23.2	24.4	25.4	26.3	27.1	27.8	28.5	29.1	29.7	30.3
Lighting	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Saturation levels expressed as percent.

3) Appliance Use:

In addition to forecasting the number of households and appliance saturation levels the contribution of each appliance to the average annual household consumption is a required input to the "end use model" used for the residential forecast.

The average annual consumption for space heating equipment was estimated at 14,000 kWh per year on the basis of data collected for the 1979 Appliance Saturation Survey. This estimate reflects a drop of 3,000 kWh/yr from the 17,000 kWh/yr estimate used in the previous load forecast. A detailed analysis of the electrically heated customers indicates that this significant change was caused mainly due to the extensive use of wood for space heating - over fifty (50) percent of the electrically heated homes indicated the use of wood as a back-up fuel in the 1979 Appliance Saturation Survey. To allow for the effects of conservation and better insulation in future, the average annual space heating consumption was decreased from 14,000 to 13,000 kWh/yr over the forecast period.

Water heaters - second only to space heating in terms of annual use per unit and their contribution to average household consumption - account for nearly twenty-five (25) percent of the current total residential electrical energy needs. The annual consumption of 4,000 kWh used in this forecast is below the 4,500 kWh/yr estimate used in the 1979 Load Forecast. This usage is based on data collected for the 1979 Appliance Saturation Survey and the results of a CEA[7] study on water heaters.

A range of the average consumption, for each of the other major appliances, was established on the basis of data available from other electrical utilities. The values applicable to New Brunswick were determined by reconciling historical appliance saturation levels and estimated average appliance consumption - for each year - with the actual aggregate household weather adjusted[8] consumption for the corresponding period. Data from 1979/80 is used to illustrate this process in Table V.

Consumption level forecast for some of the appliances has been adjusted to allow for the expected changes in trend, e.g., refrigerator and freezer consumption is increased at 1% per year to allow for the transition from manual to automatic defrost. Revised consumption levels for all major appliances and their contribution towards average household consumption - for the fiscal year 1989/90 - are also shown in Table V.

TABLE V

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL CONSUMPTION

Electrical Appliance or Equipment	1979-80 Saturation Level	Annual (2) Appliance Consumption (kWh)	Contribution to Average Household Consumption (kWh)	% of Total	1989-90 Saturation Level	Annual (2) Appliance Consumption (kWh)	Contribution to Average Household Consumption (kWh)	% of Total
(1) Heating System	22.4	14,000	3,136	30.1	33.5	13,319	4,461	36.7
(2) Water Heater	64.8	4,000	2,592	24.9	65.8	3,805	2,504	20.6
(3) Cooking Range	85.7	1,200	1,028	9.9	93.6	1,086	1,017	8.4
(4) Refrigerator	99.5	1,000	995	9.6	99.5	1,105	1,110	9.1
(5) Freezer	53.9	1,000	539	5.2	63.0	1,105	695	5.7
(6) Clothes Washer	85.9	60	52	0.5	84.8	60	51	0.4
(7) Clothes Dryer	70.4	900	634	6.1	78.1	900	703	5.8
(8) Television (B & W + Color)	100.0	400	400	3.8	100.0	328	328	2.7
(9) Air Conditioner	5.8	500	29	0.3	11.2	500	56	0.5
(10) Dishwasher	22.1	360	80	0.8	30.3	360	109	0.9
(11) Lighting	100.0	600	600	5.8	100.0	600	600	4.9
(12) Miscellaneous	100.0	327	327	3.1	100.0	533	533	4.4
(13) TOTAL			10,412				12,167	
(14) Actual Average (1) Household Consumption 1979-80			10,098					
(15) Difference Due to Weather (13)-(14) 1979-80			314					

Notes:

(1) Actual Average Consumption for 1979-80 is determined by dividing the total residential sales in 1979-80 by the number of customers at the mid point of the fiscal year.

Actual average consumption per customer in 1979-80 = $\frac{2,206,347,000 \text{ kWh}}{218,486 \text{ customers}}$ = 10,098 kWh/customer.

(2) The annual average appliance consumptions and any changes in the future is based on estimates made by NB Power and other utilities.

FORECAST RESULTS

The future housing stock and the contribution of each appliance towards average annual household consumption was calculated through specially developed computer programs. These programs ensure the accuracy of the numerous calculations required and provide an easy method for assessing the sensitivity of the forecast to changes in key variables. The "end use" approach to forecasting was applied up to the fiscal year 1989/90 and the growth rate at that point in time was used to project the Residential sales for the balance of the forecast period.

New Brunswick Electric Power Commission does not retail electricity to all of the residential customers in the province. The portion of the total forecast sales expected to be retailed by the municipal utilities in Saint John and Edmundston was determined on the basis of historical trends. This amount was allocated as residential part of the forecast for the wholesale classification.

Seasonal customers (e.g., summer cottages) are also classified as residential on the NB Power system. The electrical consumption of these customers - less than one (1) percent of the total residential sales - was forecast on the basis of simple extrapolation of historical data.

The results of this residential forecast are summarized in Table VI. The compound growth rate of 3.3% from 1980/81 to 1990/91 is below the 4.0% rate for the same period in the 1979 load forecast.

TABLE VI

FORECAST AND HISTORY OF RESIDENTIAL SALES (GWh)

Fiscal Year		Total Sales New Brunswick	Breakdown of the Total Sales NB Power Portion	Breakdown of the Total Sales Wholesale for Resale
1971-72	Actual	934	785	149
1972-73		1073	911	162
1973-74		1250	1072	178
1974-75		1487	1284	203
1975-76		1788	1554	234
1976-77		2074	1809	265
1977-78		2181	1905	276
1978-79		2274	2010	264
1979-80		2234	1975	259
1980-81		2322	2057	265
1981-82	Forecast	2457	2184	273
1982-83		2572	2292	280
1983-84		2649	2366	283
1984-85		2723	2437	286
1985-86		2792	2504	288
1986-87		2865	2573	292
1987-88		2940	2643	297
1988-89		3007	2706	301
1989-90		3079	2774	305
1990-91		3153	2844	309
1991-92		3229	2916	313
1992-93		3306	2989	317
1993-94		3387	3065	322
1994-95		3468	3142	326

FOOTNOTES

(1) NB Power 1979 Appliance Saturation Survey, pp.21.

(2) Statistics Canada Catalogue No. 91-520, Population Projections for Canada and the Provinces.

(3) Statistics Canada Catalogue No. 91-517, Household and Family Projections for Canada and the Provinces.

(4) NB Power estimates indicate that between 1977 and 1980 the household size has changed from 3.35 to 3.2.

(5) Household headship rate is the percentage of people over fifteen (15) years of age who are the head of a household.

(6) NB Power 1979 Appliance Saturation Survey.

(7) Canadian Electrical Association Research Study: The Determination of Energy Required to Produce Hot Water - 913 CU 160 (In Progress).

(8) The average annual residential consumption is quite sensitive to weather - as nearly one in four customers are electrically heated. Reconciliation of historical appliance saturation levels and annual consumption was done after adjusting the latter to "normal" weather conditions.

GENERAL SERVICE CLASSIFICATION

General Service sales also grew rapidly in the early and mid seventies - an average annual growth rate of 12.4% between 1969/70 and 1976/77. This was mainly due to the increased use of electric space and water heating. The annual sales growth rate for this classification has been close to five (5) percent in the last four (4) years.

Some of the deceleration in the growth rate for this sector is due to a number of conservation measures that have become popular in the past few years. We did not develop a quantitative assessment of the impact of conservation on the sales to this classification. However, our contacts with some of the large institutional customers indicate that specific conservation measures were in effect and positive results have been achieved in the recent years.

FORECAST METHODOLOGY

The customers in this classification have a very wide consumption range, varying from a few hundred kWh to over one million kWh per month. The nature of operations - and therefore the end use characteristics - are also quite diverse. The application of "end use analysis" - used for the Residential classification - to forecast General Service energy is not feasible at this time, due to the unavailability of appropriate data.

The key parameters which are considered to relate to the future requirements of this classification were identified to be: (1) total population, (2) population over the age of fifteen (15) years, (3) real domestic provincial product (R.D.P.P.). Historical data for each of these variables was individually correlated to the General Service sales for the corresponding time period (fiscal year). The results of the correlation equations - simple linear regressions - were then used to forecast General Service sales based on projections of population, population over fifteen (15) years or the real domestic provincial product (R.D.P.P.).

Forecast based on correlation with R.D.P.P. was not used in the final analysis for two reasons: (1) the correlation equation was less significant than in the other two cases, (2) forecasting R.D.P.P. is considered to be more difficult - hence less reliable - than the population projections.

The results based on correlation with total population and that over fifteen (15) years were found to be similar. However, the forecast based on total population was used since a large portion of the sales to this classification are related to institutions which are also affected by people under the age of fifteen, e.g., schools and hospitals.

The actual General Service consumption for the most recent fiscal year - 1980/81 - was slightly below the value based on the correlation equation. The forecast sales were thus adjusted downward - by applying the correlation based growth rates to most recent year's actual value rather than the correlation equation projected value - to allow for this difference.

The forecast obtained by relating General Service sales and population did not allow for any special developments that may take place during the forecast period. One such development - that is expected - is the extension of natural gas pipeline to New Brunswick. The effects of natural gas were incorporated in the forecast on the basis of the following key considerations:

1) Nearly eighty (80) percent of the General Service customers are in the gas service area.

2) The electric space and water heating portion of the sales to these customers is nearly twenty (20) percent of the total sales to this classification.

3) Natural gas will capture all of the new customers in this classification and thus twenty (20) percent of the otherwise expected increase in the General Service sales.

4) Natural gas will not displace any of the existing electric space heating market.

5) Approximately 3-4 GWh of General Service load is estimated to be lost each year due to conversion of existing electric water heaters to natural gas.

FORECAST RESULTS

The results of this forecast are an average annual compound growth rate of 2.9% between 1980/81 and 1990/91. This can be compared to the 6.1% rate forecast for the corresponding time interval in 1979. Principle reasons for this change are considered to be: (1) a reduction in total population projections which can be attributed to the lower level of current and expected fertility rates, (2) the present correlation factor (slope of the regression line) is significantly below but more reliable, due to a larger and more refined data base, than that used in the 1979 load forecast, (3) the potential loss of new electric space and water heating market to natural gas. The provincial forecast was allocated to NB Power retail portion and the amount sold as Wholesale for resale. Results of the forecast are summarized in Tables VII and VIII.

TABLE VII

FORECAST AND HISTORY OF GENERAL SERVICE SALES (GWh)

Fiscal Year	Total Population	General Service Sales*	Cumulative Effect of Gas Incursion	Total Sales (New Brunswick)
1971-72	636,400	Actual 707	-	707
1972-73	642,400	799	-	799
1973-74	649,300	895	-	895
1974-75	657,500	997	-	997
1975-76	669,200	1124	-	1124
1976-77	680,500	1209	-	1209
1977-78	691,000	1267	-	1267
1978-79	697,500	1347	-	1347
1979-80	702,900	1406	-	1406
1980-81	709,400	1461	-	1461
1981-82	716,300	Forecast 1524	-	1524
1982-83	722,700	1588	-	1588
1983-84	729,200	1653	(16.9)	1636
1984-85	735,800	1719	(33.6)	1685
1985-86	742,400	1782	(50.7)	1731
1986-87	748,600	1847	(67.0)	1780
1987-88	754,800	1909	(83.1)	1826
1988-89	760,700	1967	(98.8)	1868
1989-90	766,500	2024	(114.1)	1910

* Actual values up to fiscal year 1980/81 and correlation based forecast from 1981/82 onwards.

TABLE VIII

BREAKDOWN OF GENERAL SERVICE SALES (GWh)

Fiscal Year		Total Sales New Brunswick	Breakdown of the Total Sales: NB Power Portion	Breakdown of the Total Sales: Wholesale for Resale
1971-72	Actual	707	540	167
1972-73		799	618	181
1973-74		895	695	200
1974-75		997	775	222
1975-76		1124	872	252
1976-77		1209	935	274
1977-78		1266	984	282
1978-79		1347	1072	275
1979-80		1406	1118	288
1980-81		1461	1165	296
1981-82	Forecast	1524	1215	309
1982-83		1588	1266	322
1983-84		1636	1304	332
1984-85		1685	1343	342
1985-86		1731	1380	351
1986-87		1780	1419	361
1987-88		1826	1455	371
1988-89		1868	1489	379
1989-90		1910	1522	388
1990-91		1948	1553	395
1991-92		1987	1584	403
1992-93		2026	1615	411
1993-94		2068	1648	420
1994-95		2109	1681	428

INDUSTRIAL DISTRIBUTION CLASSIFICATION

This classification - like General Service - encompasses customers with wide diversity in size and nature of operations. However, unlike the Residential and General Service classifications, the Industrial Distribution growth rate over the last four years (5.1%) has not differed significantly from the average annual rate of 5.3% in the last ten (10) years.

Nearly one-half of the customers and two-thirds of the Industrial Distribution sales are related to the manufacturing sector[1]. As most of the electrical energy sold to this group of customers is used for machinery and processing it has not been, nor expected to be, subject to substitution by alternate fuels such as wood or natural gas. However, conservation measures may influence the requirements of this group. With increasing prices of electricity the high initial cost "energy efficient" motors are now considered economically justifiable if evaluated on a life cycle cost basis[2,3]. This is likely to impact future decision for replacement and new motors. However, its effect on future electrical energy needs by Industrial Distribution customers is not quantified in this forecast.

FORECAST METHODOLOGY

The key economic parameters which affect the sales for this classification are the total real domestic provincial product (R.D.P.P.) and its goods producing and manufacturing sector components. However, the sales to other classifications - mainly Industrial Transmission - are also influenced by the level of R.D.P.P. Thus any changes in the real domestic provincial product as a result of unusual conditions (e.g., a prolonged strike) prevailing in a particular industry may have no effect on the Industrial Distribution electrical energy needs[4].

This limits our ability to correlate past data points (quarterly or yearly) for sales to this classification and the R.D.P.P. However, the long term relationship between the growth rate for these two variables is expected to reflect the nature and magnitude of the effect of R.D.P.P. on Industrial Distribution electrical energy requirements.

Annual values and percentage changes - since 1969 - for Industrial Distribution sales and the R.D.P.P. for manufacturing, goods producing and all sectors combined are given in Table IX. The average annual compound growth rate for each data base is also compared.

The relationship between the growth rates for Industrial Distribution sales and goods producing sector R.D.P.P. was considered most reliable as this sector of New Brunswick economy accounts for nearly all of the

TABLE IX

INDUSTRIAL DISTRIBUTION SALES AND R.D.P.P. CHARACTERISTICS

			REAL DOMESTIC PROVINCIAL PRODUCT* (Millions of Dollars)					
Fiscal Year	Industrial Distribution Sales (GWh)	Annual Growth Rate	Manufacturing Sector	Annual Growth Rate	Good Producing Sector	Annual Growth Rate	All Industries	Annual Growth Rate
1969-70	218		249		516		1461	
1970-71	211	-3.2	243	-2.4	530	2.7	1527	4.5
1971-72	235	11.4	250	2.9	534	0.7	1607	5.2
1972-73	252	7.2	289	15.6	585	9.6	1718	6.9
1973-74	265	5.2	328	13.5	675	15.4	1873	9.0
1974-75	280	5.7	338	3.0	713	5.6	1966	5.0
1975-76	303	8.2	308	-8.9	689	-3.4	1986	1.0
1976-77	316	4.3	305	-1.0	686	-0.4	2035	2.5
1977-78	319	0.9	310	1.6	686	0	2069	1.7
1978-79	343	7.5	326	5.2	714	4.1	2118	2.4
1979-80	366	6.7	337	3.4	717	0.4	2153	1.7
1980-81	386	5.5	343	1.8	695	-3.1	2140	0.6
Average Annual Growth Rate	5.3		3.0		2.7		3.5	
Ratio of Industrial Distribution Sales Growth to R.D.P.P. Growth			1.8		2.0		1.5	

*Source: The Provincial Economies 1961-1979 Data; A Supplement to the Quarterly Provincial Forecast by Conference Board of Canada.

electrical energy sales to this customer classification. Based on a nominal growth rate of 2.5% per year for goods producing sector R.D.P.P. - slightly below the 10 year historical average of 2.7% - the sales to this customer group were forecast to grow at five (5) percent per year.

FORECAST RESULTS

Results of the forecast - an annual growth rate of 5.0% - and historical data are shown in Table X. The provincial total was allocated to NB Power retail porcion and Wholesale for resale on the basis of past trends. The results of this forecast are identical to that prepared in 1979.

TABLE X

FORECAST AND HISTORY OF INDUSTRIAL DISTRIBUTION (GWh)

		Breakdown of the Total Sales	
Fiscal Year	Total Sales New Brunswick	NB Power Portion	Wholesale for Resale
1971-72	Actual 235	189	46
1972-73	252	199	53
1973-74	265	205	60
1974-75	280	217	63
1975-76	303	238	65
1976-77	316	251	65
1977-78	319	255	64
1978-79	343	283	60
1979-80	372	305	67
1980-81	401	329	72
1981-82	Forecast 423	347	76
1982-83	445	365	80
1983-84	467	383	84
1984-85	490	402	88
1985-86	515	422	93
1986-87	540	443	97
1987-88	567	465	102
1988-89	596	489	107
1989-90	626	513	113
1990-91	657	539	118
1991-92	690	566	124
1992-93	724	594	130
1993-94	761	624	137
1994-95	799	655	144

FOOTNOTES

(1) Based on an analysis of the billing records for Industrial Distribution customers for the fiscal year 1980-81.

(2) "Energy Efficient Motors" by the Energy Conservation and Utilization Division, B.C. Hydro.

(3) "Canadian Energy Efficient Electric Motor Program" by the Energy Conservation Division, Ontario Hydro.

(4) The economic activity (R.D.P.P.) of the manufacturing sector also affects the sales to Industrial Transmission customers. A change in the output and energy requirements - in any year - of one very large Industrial Transmission customer could thus distort the R.D.P.P. data without changing Industrial Distribution sales, e.g., the seven month strike at MacMillan Rothesay Ltd., in 1979 had a significant impact on manufacturing sector R.D.P.P. and no impact on Industrial Distribution electrical energy sales.

STREET LIGHTS CLASSIFICATION

The classification of customer includes energy sold to Commission owned street lights, customer owned facilities, off-street dusk to dawn facilities and other special services such as railway crossing signals. The Street Lights classification represents a very small proportion (just over one-half of one percent) of the total "in-province" sales by NB Power.

Between 1970 and 1977 the energy sales to this classification grew at an average annual rate of 8.7%. This growth rate has decelerated significantly during the last few years - to about three (3) percent per year.

FORECAST METHODOLOGY AND RESULTS

Recent development of low wattage and high efficiency sodium lights and general conservation measures by municipalities are considered responsible for the decline in the sales growth rate for this classification of customers.

The gradual switch to high efficiency street lights is expected to continue and therefore impact future growth rate - for this customer group. The three (3) percent growth rate forecast for this classification was based on the trend over the last three years. This rate is significantly below the six (6) percent growth forecast in 1979.

Results of the forecast and historical data for this customer classification are summarized in Table XI. The total Street Lights energy sales for the province were allocated to the NB Power share and the amount sold as Wholesale for resale.

TABLE XI

FORECAST AND HISTORY OF STREET LIGHTS SALES (GWh)

Fiscal Year		Total Sales New Brunswick	Breakdown of the Total Sales: NB Power Portion	Breakdown of the Total Sales: Wholesale for Resale
1971-72	Actual	36	25	11
1972-73		39	27	12
1973-74		42	30	12
1974-75		46	35	11
1975-76		50	39	11
1976-77		53	42	11
1977-78		56	44	12
1978-79		57	47	10
1979-80		59	49	10
1980-81		61	50	11
1981-82	Forecast	63	52	11
1982-83		66	54	12
1983-84		67	55	12
1984-85		69	57	12
1985-86		72	59	13
1986-87		73	60	13
1987-88		75	62	13
1988-89		78	64	14
1989-90		80	66	14
1990-91		83	68	15
1991-92		85	70	15
1992-93		87	72	15
1993-94		90	74	16
1994-95		94	77	17

WHOLESALE (FOR RESALE) CLASSIFICATION

The cities of Saint John and Edmundston own and operate utilities for the purpose of retailing electricity to the Residential, General Service, Industrial Distribution and Street Lights classifications. The two utilities purchase electrical energy from NB Power at transmission voltages and distribute it to their retail customers.

FORECAST METHODOLOGY

The future electrical energy requirements for these two cities was estimated by preparing a total provincial forecast for each of the four customer classifications which are served by these cities and then allocating the portion retailed directly by NB Power and the Wholesale for Resale on the basis of past trends. Results of the allocation were shown in the previous four sections of this document.

FORECAST RESULTS

The electrical energy sales to this customer classification are forecast at 2.6% between 1980/81 to 1990/91. This can be compared to the 4.6% rate forecast in 1979. Table XII shows the history and forecast for the total Wholesale classification and a breakdown into its four components.

TABLE XII

WHOLESALE FORECAST AND HISTORY (GWh)

		Breakdown of Total Sales by Classification			
Fiscal Year	Total* Sales	Residential	General Service	Industrial Distribution	Street Lights
1971-72	Actual 373	149	167	46	11
1972-73	408	162	181	53	12
1973-74	450	178	200	60	12
1974-75	499	203	222	63	11
1975-76	562	234	252	65	11
1976-77	615	265	274	65	11
1977-78	633	276	282	64	11
1978-79	609	264	275	60	10
1979-80	624	259	288	67	10
1980-81	644	265	296	72	11
1981-82	Forecast 669	273	309	76	11
1982-83	694	280	322	80	12
1983-84	711	283	332	84	12
1984-85	728	286	342	88	12
1985-86	745	288	351	93	13
1986-87	763	292	361	97	13
1987-88	783	297	371	102	13
1988-89	801	301	379	107	14
1989-90	820	305	388	113	14
1990-91	837	309	395	118	15
1991-92	855	313	403	124	15
1992-93	873	317	411	130	15
1993-94	895	322	420	137	16
1994-95	915	326	428	144	17

* Total may not add up to the sum of the parts due to rounding errors.

* The sales from 1971/72 to 1977/78 also include the amount purchased by Campbellton Electric Light Department directly from Hydro Quebec.

This 2.0% drop in growth rate can be attributed to all of the factors which affected the forecast for Residential, General Service, Industrial Distribution and Street Lights classifications, e.g., conservation, wood, population growth rates. The growth rate for Saint John and Edmundston is also anticipated to be lower than that for the remainder of the province due to the confined boundaries of the electrical service area.

INDUSTRIAL TRANSMISSION CLASSIFICATION

This classification has nearly forty large industrial customers, each with its individual substation and supplied electrical energy at transmission voltages. The customers range in size from nearly one to one hundred MW of connected load. Industrial Transmission sales growth has been relatively stable in the last decade - an average annual rate of nearly four percent.

FORECAST METHODOLOGY

The forecast for this customer group is made up of four components:

1) Firm Load: requirements of existing and known potential customers.
2) Allowance for Development.
3) Contract Sales.
4) Interruptible Sales.

Industrial Firm

The needs of existing customers were forecast by consulting the senior management and/or technical experts at customer locations. These people are periodically interviewed to determine potential changes in load that may result from planned expansions, closures, fuel substitution or conservation. Forecast for each individual customer was prepared by incorporating this information and historical growth patterns.

Allowance for Development

All electric utilities are frequently faced with unexpected requests for electrical service to supply a new or expanding industrial customer. The growth from developments - for NB Power - has averaged about 15 MW per year over the last seven years.

Most large industrial developments require from three (3) to five (5) years of planning to be in operation and therefore often provide the utility with some lead time. Generally one or more Provincial and/or Federal Government agencies are involved in the development phases of a new industrial customer. These agencies are usually concerned with financial, environmental and regulatory aspects of the industry. The governmental involvement often provides sufficient information related to the size and nature of planned operations and the degree of uncertainty related to the proposed industrial development. Periodic contact is maintained with relevant departments and agencies which include Federal Department of Regional Economic Expansion, New Brunswick Ministry of Commerce and Development and New Brunswick Department of Natural Resources. The expected load and probability of success is established on the basis of available information. In nearly all cases the potential customers contact NB Power directly for forecast of power rates and availability - thus providing direct information on the potential addition(s).

Therefore, this "informed opinion" approach was considered particularly indicative of developments in the first two (2) years of the forecast. The longer term historical average of 15 MW per year was used for the remaining time period of the forecast.

Contract Sales

This classification is based on a single customer - a cogeneration facility with MacMillan Rothesay Ltd. - for the sale of steam and electricity from our Courtenay Bay No. 2 Unit in Saint John. Contract sales - in the last few years - have been relatively steady between 75 and 80 GWh/year with the exception of the fiscal years 1975/76 and 1979/80 - effected by labour disputes at customer location. The sales have been forecast at 75 GWh/year up to March, 1995.

Interruptible Sales

Industrial Transmission customers can purchase interruptible power as a substitute to their own generating capacity.

The sales for this type of purchase have fluctuated widely in the past. Most fluctuations have resulted from market or strike related problems within the pulp and paper industry. Higher than normal river flows from time to time lead to availability of lower cost interruptible power and consequently larger sales for this classification.

This type of energy sale is made only when excess capacity is available and it does not have any direct bearing on NB Power's generation planning. The current trend of 250 GWh is forecast to continue up to the fiscal year 1994/95.

FORECAST RESULTS

The sales to this classification are forecast to grow at an overall average compound annual growth rate of 4.0% between the fiscal years 1980/81 and 1990/91. This compares with the 3.6% rate forecast in the 1979 load forecast. The total Industrial Transmission forecast and breakdown into its four components is shown in Table XIII.

TABLE XIII

FORECAST AND HISTORY OF INDUSTRIAL TRANSMISSION SALES (GWh)

Fiscal Year		Total Sales	Breakdown of the Total: Firm Load	Contract	Interruptible	Allowance for Development
1971-72	Actual	2176	1752	382	42	–
1972-73		2454	2005	388	61	–
1973-74		2509	2089	331	89	–
1974-75		2651	2232	320	99	–
1975-76		2381	2254	53	74	–
1976-77		2857	2666	75	116	–
1977-78		2978	2758	80	140	–
1978-79		3108	2872	68	168	–
1979-80		2853	2630	25	198	–
1980-81		3301	2933	75	293	–
1981-82	Forecast	3487	3112	75	300	–
1982-83		3890	3565	75	250	–
1983-84		4046	3616	75	250	105
1984-85		4186	3651	75	250	210
1985-86		4310	3670	75	250	315
1986-87		4420	3675	75	250	420
1987-88		4533	3683	75	250	525
1988-89		4645	3690	75	250	630
1989-90		4758	3698	75	250	735
1990-91		4872	3707	75	250	840
1991-92		4986	3715	75	250	946
1992-93		5100	3724	75	250	1051
1993-94		5214	3733	75	250	1156
1994-95		5324	3738	75	250	1261

"IN-PROVINCE" SYSTEM NET ENERGY FORECAST

The total "in-province" energy forecast - generally referred to as System Net - includes sales to all six customer classifications within the Province of New Brunswick together with the associated distribution and transmission losses. The System Net energy does not include export sales or the energy used for station service at our generating plants. The distribution losses are forecast at 5.5% of the sales at distribution voltages and the transmission losses which relate to the total "in-province" supply are forecast at 7.0%. These losses are forecast on the basis of recent system performance.

The yearly forecast of energy for each classification - and the corresponding actuals for the past four years - are shown in Tables XIV(a) and XIV(b). The amount of distribution and transmission losses are also shown. The percentage of sales for major customer classifications for the fiscal years 1981/82 and 1994/95 are shown in Figure I.

TABLE XIV (a)

LOAD FORECAST (GWH)
FISCAL YEAR ENDING MARCH 31
NEW BRUNSWICK ELECTRIC POWER COMMISSION

	CLASSIFICATION	1977-78 ACTUAL	1978-79 ACTUAL	1979-80 ACTUAL	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
1.	RESIDENTIAL	1,905	2,010	1,975	2,079 (1)	2,184	2,292	2,366	2,437	2,504
	PERCENTAGE INCREASE	-	5.5	-1.7	5.3	5.0	5.0	3.2	3.0	2.8
2.	GENERAL SERVICE	984	1,072	1,118	1,165	1,215	1,266	1,304	1,343	1,380
		-	8.9	4.3	4.2	4.3	4.2	3.0	3.0	2.8
3.	STREET LIGHTS	44	47	49	50	52	54	55	57	59
		-	6.5	4.7	3.0	3.0	3.0	3.0	3.0	3.0
4.	INDUSTRIAL DISTRIBUTION	255	283	305	329	347	365	383	402	422
		-	11.1	7.8	8.0	5.4	5.0	5.0	5.0	5.0
5.	TOTAL DISTRIBUTION SALES	3,189	3,413	3,448	3,625	3,800	3,978	4,109	4,240	4,367
		-	7.0	1.0	5.1	4.8	4.7	3.3	3.2	3.0
6.	DISTRIBUTION LOSSES	183	143	209	199	209	218	226	233	240
		-	21.7	45.4	4.5	4.8	4.7	3.3	3.2	3.0
7.	TOTAL DISTRIBUTION SUPPLY	3,373	3,557	3,657	3,825	4,009	4,197	4,335	4,474	4,607
		-	5.5	2.8	4.6	4.8	4.7	3.3	3.2	3.0
8.	WHOLESALE TRANSMISSION	599	614	627	640	665	690	707	723	739
		-	2.4	2.2	2.1	3.9	3.7	2.4	2.4	2.2
9.	TOTAL VARIABLE SUPPLY	3,972	4,171	4,285	4,466	4,674	4,887	5,042	5,198	5,347
		-	5.0	2.7	4.2	4.7	4.5	3.2	3.1	2.9
10.	INDUSTRIAL-FIRM	2,758	2,872	2,630	2,933	3,112	3,565	3,616	3,651	3,670
	-ALLOWANCE FOR DEVELOPMENT	0	0	0	0	0	0	105	210	315
	-CONTRACT	80	68	25	75	75	75	75	75	75
	-INTERRUPTIBLE	140	168	198	293	300	250	250	250	250
	-TOTAL	2,978	3,109	2,853	3,301	3,487	3,890	4,046	4,186	4,310
		-	4.4	-8.1	15.7	5.6	11.6	4.0	3.5	3.0
11.	TOTAL IN-PROVINCE SUPPLY	6,951	7,281	7,139	7,767	8,161	8,777	9,088	9,384	9,657
		-	4.7	-1.9	8.8	5.1	7.5	3.5	3.3	2.9
12.	TRANSMISSION LOSSES	593	631	484	543	571	614	636	656	676
13.	SYSTEM NET	7,545	7,912	7,623 (2)	8,311 (3)	8,732	9,391	9,724	10,041	10,333
		-	4.9	-3.5	9.0	5.1	7.5	3.5	3.3	2.9

NOTES:

(1) This is the estimated level of residential consumption for "normal" weather conditions.

(2) The System Net value is approximately 400 GWh less than expected due to a seven month strike at MacMillan Rothesay, Ltd.

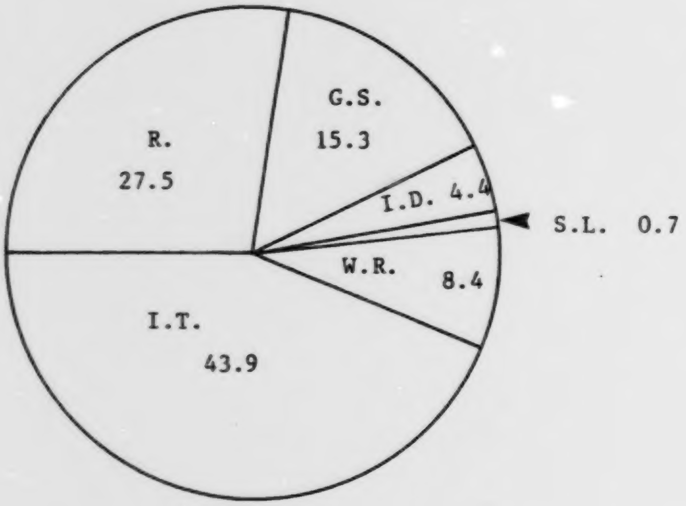
(3) The System Net value is approximately 72 GWh less than expected due to a four month strike at Brunswick Mining Operations.

TABLE XIV (b)

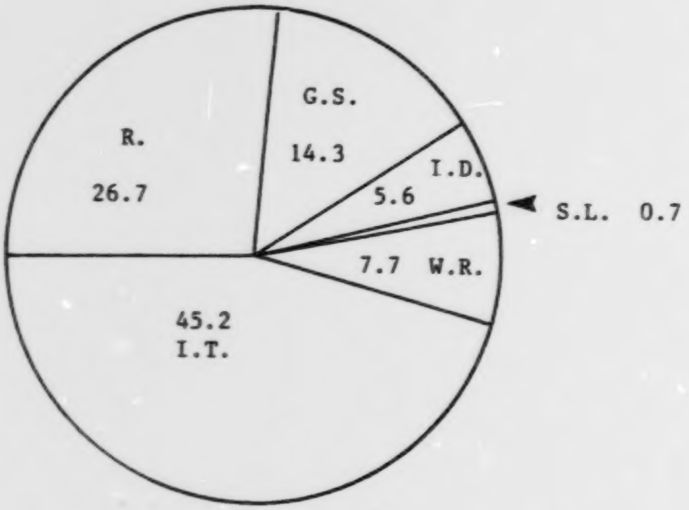
LOAD FORECAST (GWH)
FISCAL YEAR ENDING MARCH 31
NEW BRUNSWICK ELECTRIC POWER COMMISSION

CLASSIFICATION	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95
1. RESIDENTIAL	2,573	2,643	2,706	2,774	2,844	2,916	2,989	3,065	3,142
PERCENTAGE INCREASE	2.7	2.7	2.4	2.5	2.5	2.5	2.5	2.5	2.5
2. GENERAL SERVICE	1,419	1,455	1,489	1,522	1,553	1,584	1,615	1,648	1,681
	2.8	2.5	2.4	2.2	2.0	2.0	2.0	2.0	2.0
3. STREET LIGHTS	60	62	64	66	68	70	72	74	77
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
4. INDUSTRIAL DISTRIBUTION	443	465	489	513	539	566	594	624	655
	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
5. TOTAL DISTRIBUTION SALES	4,497	4,627	4,750	4,877	5,005	5,137	5,273	5,412	5,556
	3.0	2.9	2.7	2.7	2.6	2.6	2.6	2.7	2.7
6. DISTRIBUTION LOSSES	247	254	261	268	275	282	290	297	305
	3.0	2.9	2.7	2.7	2.6	2.6	2.6	2.7	2.7
7. TOTAL DISTRIBUTION SUPPLY	4,744	4,881	5,011	5,145	5,280	5,419	5,563	5,710	5,862
	3.0	2.9	2.7	2.7	2.6	2.6	2.6	2.7	2.7
8. WHOLESALE TRANSMISSION	759	777	795	813	831	849	868	887	907
	2.6	2.5	2.3	2.3	2.2	2.2	2.2	2.2	2.2
9. TOTAL VARIABLE SUPPLY	5,503	5,659	5,807	5,959	6,112	6,269	6,431	6,596	6,769
	2.9	2.8	2.6	2.6	2.6	2.6	2.6	2.6	2.6
10. INDUSTRIAL-FIRM	3,675	3,683	3,690	3,698	3,707	3,715	3,724	3,733	3,738
-ALLOWANCE FOR DEVELOPMENT	420	525	630	735	840	946	1,051	1,156	1,261
-CONTRACT	75	75	75	75	75	75	75	75	75
-INTERRUPTIBLE	250	250	250	250	250	250	250	250	250
-TOTAL	4,420	4,533	4,645	4,758	4,872	4,986	5,100	5,214	5,324
	2.6	2.6	2.5	2.4	2.4	2.3	2.3	2.2	2.1
11. TOTAL IN-PROVINCE SUPPLY	9,924	10,193	10,452	10,717	10,985	11,255	11,531	11,812	12,094
	2.8	2.7	2.5	2.5	2.5	2.5	2.5	2.4	2.4
12. TRANSMISSION LOSSES	694	713	731	750	768	787	807	826	846
13. SYSTEM NET	10,618	10,906	11,184	11,468	11,754	12,043	12,339	12,639	12,940
	2.8	2.7	2.5	2.5	2.5	2.5	2.5	2.4	2.4

IN-PROVINCE ENERGY SALES



1981-82



1994-95

R. - Residential
G.S. - General Service
I.D. - Industrial Distribution
S.L. - Street Lights
W.R. - Wholesale for Resale
I.T. - Industrial Transmission

FIGURE I

NOTE:

Percentages may not add up to 100.0 due to rounding errors.

MONTHLY BREAKDOWN OF THE FORECAST

In order for the load forecast to be used most effectively in the overall utility planning process it is necessary to further breakdown the annual energy forecast into monthly values and to forecast the peak hourly demand associated with each month's energy sales. The procedure for allocating annual energy over the twelve months and converting it into peak demand is outlined in the Flowchart II.

MONTHLY ENERGY

Each fiscal year System Net energy forecast was divided into two components, (i) "variable" which includes Residential, General Service, Industrial Distribution, Street Lighting and Wholesale customers and (ii) "Industrial Transmission". The monthly allocation of the variable part of the total energy was done on the basis of historical data which had been normalized for the differences between actual and "normal" weather conditions. No adjustments were made to allow for possible changes in the monthly distribution of energy throughout the forecast period. The monthly allocation of industrial energy was also based on historical ratios - adjusted for the effects of non-routine plant closures resulting from strikes. Results of the monthly breakdown are shown in Table XV.

TABLE XV

IN-PROVINCE ENERGY (GWh)

Fiscal Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Annual Total
1981-82	724	661	630	631	615	642	703	739	871	890	804	823	8732
1982-83	786	720	687	684	664	683	759	791	930	950	857	881	9391
1983-84	814	746	711	709	688	707	786	819	963	983	886	912	9724
1984-85	840	770	734	732	711	730	812	846	994	1015	915	942	10041
1985-86	865	793	756	753	732	752	835	870	1023	1044	941	969	10333
1986-87	889	815	776	774	752	773	858	894	1051	1073	967	996	10618
1987-88	913	837	797	795	773	793	881	919	1080	1103	993	1023	10906
1988-89	936	859	817	816	792	814	903	942	1108	1131	1018	1049	11184
1989-90	959	881	837	837	813	834	926	966	1136	1159	1044	1075	11468
1990-91	983	903	858	857	833	855	948	990	1164	1188	1070	1102	11754
1991-92	1008	925	879	879	854	876	971	1014	1193	1218	1096	1129	12043
1992-93	1032	948	900	900	875	898	995	1039	1223	1248	1123	1157	12339
1993-94	1057	972	922	922	896	919	1019	1064	1253	1279	1150	1185	12639
1994-95	1083	995	943	944	917	941	1043	1090	1283	1309	1178	1214	12940

PEAK HOURLY DEMAND

The timing of new facilities depends to a large degree on the forecast of peak hourly demand for the system. The most significant factors in the determination of the peak demand are shown in Flowchart II and discussed below.

Annual Load Factor:

Variable: The annual load factor for the variable part of the system has decreased steadily in recent years - from 51.3 in 1972/73 to 47.2 by year ending March, 1980/81 (Table XVI). To allow for the reduction expected as a result of the incremental load factor - during the past seven years - being below the average load factor the forecast of load factors for the variable load was gradually reduced to 46% by the fiscal year 1994/95.

Industrial: Load factors for the Industrial Transmission part were based on individual customer analysis up to the fiscal year 1984/85 and then gradually reduced from 82.5 to 81% by the end of the forecast period. The provision for industrial development was included at 80% load factor.

FLOWCHART II

PEAK DEMAND FORECAST PROCEDURE

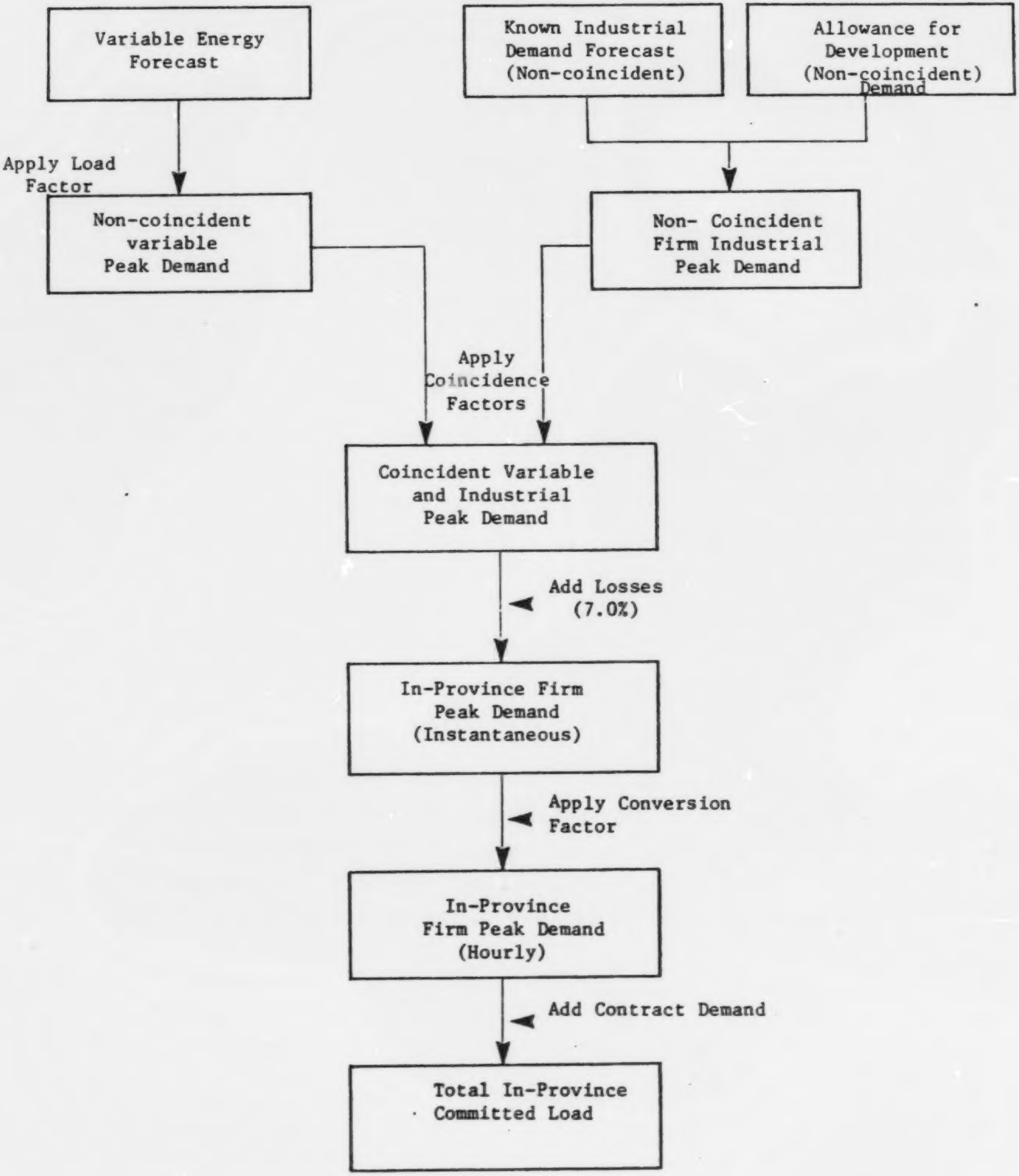

Variable Energy Forecast
Known Industrial Demand Forecast (Non-coincident)
Allowance for Development (Non-coincident) Demand
Apply Load Factor
Non-coincident variable Peak Demand
Non- Coincident Firm Industrial Peak Demand
Apply Coincidence Factors
Coincident Variable and Industrial Peak Demand
Add Losses (7.0%)
In-Province Firm Peak Demand (Instantaneous)
Apply Conversion Factor
In-Province Firm Peak Demand (Hourly)
Add Contract Demand
Total In-Province Committed Load

TABLE XVI

VARIABLE ENERGY LOAD FACTORS

Fiscal Year	Variable Energy (GWh)	Variable Demand (MW)	Load Factor (%)
1972-73	2,262	504	51.3
1973-74	2,538	569	50.9
1974-75	2,935	665	50.4
1975-76	3,384	778	49.6
1976-77	3,792	890	48.6
1977-78	3,927	923	48.6
1978-79	4,172	1035	46.0
1979-80	4,294	989	49.6
1980-81	4,436	1072	47.2

Note:

The energy and demand values shown in this table are not adjusted for the effects of variations in weather conditions.

Coincidence Factor:

The coincidence factors used in determining peak demand are based on an analysis of historical data for the peak months of December, January and February. The average coincidence factors of 0.95 for variable load and 0.97 for industrial load were used in this forecast.

FORECAST RESULTS

The monthly energy breakdown and peak hourly demand were derived by using a specially developed computer program. Peak hourly demands for each month of the forecast period are shown in Table XVII. The average annual rate of 3.7% between 1980/81 and 1990/91 compares to the 4.4% rate forecast in 1979.

TABLE XVII

IN-PROVINCE HOURLY LOAD (MW)

Month

Fiscal Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	(1) Jan.	Feb.	Mar.
1981-82	1289	1223	1162	1123	1113	1200	1251	1375	1581	1591	1505	1426
1982-83	1393	1323	1257	1210	1194	1268	1340	1463	1680	1690	1597	1519
1983-84	1446	1374	1306	1257	1240	1317	1391	1519	1743	1754	1658	1576
1984-85	1497	1421	1352	1302	1285	1364	1440	1572	1803	1815	1715	1631
1985-86	1545	1469	1396	1345	1326	1408	1487	1623	1861	1872	1770	1683
1986-87	1593	1514	1440	1386	1368	1452	1533	1673	1918	1930	1825	1736
1987-88	1641	1560	1483	1428	1409	1495	1579	1723	1976	1988	1880	1788
1988-89	1688	1605	1525	1469	1449	1538	1624	1772	2032	2045	1933	1839
1989-90	1736	1650	1569	1511	1491	1582	1670	1822	2089	2102	1988	1890
1990-91	1784	1696	1612	1553	1532	1626	1716	1873	2147	2160	2043	1943
1991-92	1833	1743	1657	1596	1574	1670	1763	1924	2205	2220	2099	1996
1992-93	1883	1790	1702	1640	1618	1716	1811	1977	2266	2281	2157	2051
1993-94	1934	1839	1748	1684	1661	1763	1861	2030	2328	2343	2215	2107
1994-95	1986	1889	1795	1730	1706	1810	1911	2085	2391	2406	2275	2163

(1) Represents fiscal year peak demand.

APPENDIX A

POPULATION

Forecast of electrical energy consumption is largely dependent on the changes in population. Increase in population leads to a larger number of households, together with more commercial activity, such as a need for more schools and hospitals, thereby causing a greater demand for electrical energy. Future population levels are dependent on three events; births, deaths and migration.

Births are a function of fertility rates and female population in the child bearing age. Fertility rates fluctuate with socio-economic conditions and are difficult to forecast. Table I shows the trend of actual fertility rates in the past and compares these with the four projections made by Statistics Canada after the 1976 census.

Deaths are a function of mortality rates, the total population and its age structure. As shown in Table II the past actual mortality rates are relatively stable and also quite close to the levels projected by Statistics Canada.

Migration patterns, which are generally considered to be dependent on economic conditions, are perhaps the hardest to forecast. Table III shows the most recent changing pattern for New Brunswick. Recent estimates by the OEA[1] indicate near zero migration levels (immigration equal to emigration) in 1980.

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[1] The Office of the Economic Advisor, Department of Finance, Province of New Brunswick.

Population forecast is thus dependent on the accuracy of the projections for each of the above variables. For the purpose of forecasting households - a key element of residential electrical energy consumption - the uncertainty of fertility rates can be eliminated by basing our fifteen year forecast on population over fifteen years of age (those likely to form the head of a household). Births between now and the end of the forecast period will not result in people over fifteen and therefore not affect our estimates of household formation, leaving only deaths and migration as uncertain. For other uses, e.g., commercial sector growth which includes schools and hospitals, we need a forecast of the total population.

The overall fertility rate since 1976 and the rate for each of the past three years are closest to the levels in Statistics Canada Projection #3. Mortality rates are identical for all projections and close to the actual experience. The Office of the Economic Advisor, Province of New Brunswick, is currently recommending the use of demographic characteristics of the population projection #3 by Statistics Canada. For these reasons we have applied the growth rates in this population projection to the estimates of actual population in arriving at the forecast for the next fifteen years.

Unlike Statistics Canada projections we have not allowed for any migration levels in our population forecast. The past reversals in migration levels (Table III), which started in 1971, support the assumption that in the long run there is an equal likelihood for immigration or emigration. For this reason zero migration levels are used in the "base case" forecast. This assumption should therefore provide the situation for least possible error in the forecast.

The resulting projections for total population and that over fifteen used in this forecast are shown in Table IV. This forecast has been adjusted downward in 1980 by 2000 to reflect the lower than projection #3 expected total population level experienced to 1980.

TABLE I

FERTILITY RATES*

Year	Actual	# 1	# 2	# 3	# 4
		Statistics Canada Projections			
1976	8.1	7.9	7.9	7.6	7.6
1977	7.9	7.9	7.9	7.4	7.4
1978	6.8	7.9	7.9	7.3	7.3
1979	6.6	7.9	7.9	7.2	7.2
1980	6.5	7.9	7.9	7.2	7.2
Overall rate	7.1	7.9	7.9	7.3	7.3
1985	-	7.8	7.9	6.8	6.9
1990	-	7.4	7.4	6.2	6.2
1995	-	6.9	6.8	5.7	5.7

* Births per year per 100 of female population between the ages of 15 to 44.

Sources: (1) Canadian Statistical Review, 11-003E.
(2) Population Projections for Canada and the Provinces, S.C. Cat. No. 91-514.

TABLE II

MORTALITY RATES*

Year	Actual	# 1	# 2	# 3	# 4
		Statistics Canada Projections			
1976	7.7	8.0	8.0	8.0	8.0
1977	7.7	7.9	7.9	7.9	7.9
1978	7.5	7.9	7.9	7.9	7.9
1979	7.7	7.8	7.8	7.8	7.8
1980	7.8	7.9	7.8	7.9	7.8
Overall rate	7.7	7.9	7.9	7.9	7.9
1985	-	8.0	7.8	7.8	7.7
1990	-	8.3	8.0	8.2	7.9
1995	-	8.6	8.3	8.6	8.2

* Deaths per year per 1000 of total population.

Sources: (1) Canadian Statistical Review, 11-003E.
(2) Population Projection for Canada and the Provinces, S.C. Cat. No. 91-514.

TABLE III

MIGRATION LEVELS*

Year	No. of Migrants In (Out)
1966-67	(9,738)
1967-68	(6,052)
1968-69	(7,155)
1969-70	(9,893)
1970-71	(1,435)
1971-72	1,051
1972-73	2,876
1973-74	2,757
1974-75	7,521
1975-76	7,884
1976-77	3,217
1977-78	1,537
1978-79	589
TOTAL	(6,841)

* Source: Estimates made by the Office of the Economic Advisor, Department of Finance, Province of New Brunswick.

TABLE IV

POPULATION PROJECTIONS

Year*	Total	Population Over Age 15	
1976	680,500	488,200	
1977	691,000	500,400	
1978	697,500	511,800	
1979	702,900	521,700	
1980	709,400	530,400	ESTIMATES[1]
1981	716,300	538,900	PROJECTIONS[2]
1982	722,700	546,000	
1983	729,200	552,600	
1984	735,800	558,800	
1985	742,200	565,300	
1986	748,600	571,700	
1987	654,800	577,900	
1988	760,700	583,400	
1989	766,500	588,600	
1990	772,100	593,800	
1991	777,300	598,900	
1992	782,200	603,700	
1993	786,900	608,800	
1994	791,400	613,900	

* The values are as of October 1 for each year, the mid point of NB Power fiscal year.

[1] Estimates up to 1980 are based on "Population by Sex and Age for Canada and the Provinces"; Statistics Canada Catalogue No. 91-202.

[2] Projections for 1981-1995 are based on "Population Projections for Canada and the Provinces" Statistics Canada Catalogue No. 91-520.

Appendix B

HEADSHIP RATE PROJECTION

Headship rate is defined as the number or proportion of household heads in a given population group. In this forecast it is the proportion of household heads among the population over fifteen years of age. The use of headship rate in determining future housing stock is a widely accepted technique and is used by agencies such as Statistics Canada.

The Statistics Canada estimate for the headship rate in New Brunswick, based on 1971 census[1], was below the NB Power estimate. Also Statistics Canada estimates are only available for five year intervals. For these reasons we have determined the historical headship rate in New Brunswick by using NB Power estimates of residential customers and Statistics Canada estimates of population over the age of fifteen (Table I).

Historical trend for headship rate shows a steady increase since 1971. This change can be attributed to several factors including: greater acceptance of single women forming a separate household, increases in divorce rates and increases in household formation by the younger age cohorts.

Headship rate in this forecast is projected by fitting a least squares logarithmic curve through historical data. The results of the least squares fit are adjusted to correct the difference between the current actual and curve fit value. Projected values are shown in Table II.

---

[1] Household and Family Projections for Canada and the Provinces to 2001: Statistics Canada Catalogue No. 91-517.

TABLE I

HEADSHIP RATE ESTIMATES

Fiscal Year	NB Power Estimate	Statistics Canada* Estimate(1)
1971-72	37.556	37.7
1972-73	38.505	
1973-74	39.629	
1974-75	40.648	
1975-76	40.905	
1976-77	41.573	38.4
1977-78	41.845	
1978-79	41.864	
1979-80	41.881	
1980-81	41.891	
1981-82	42.007	38.9

* Statistics Canada estimates do not correspond exactly with NB Power fiscal year.

(1) Source: Household and Family Projections to Canada and the Province for 2001. Catalogue No. 91-517.

TABLE II

HEADSHIP RATE FORECAST*

Year	Curve Fit Value (1)	Adjusted Value (2)
1981-82	42.068	42.007
1982-83	42.149	42.088
1983-84	42.221	42.160
1984-85	42.286	42.225
1985-86	42.345	42.284
1986-87	42.400	42.339
1987-88	42.451	42.390
1988-89	42.498	42.437
1989-90	42.542	42.481

(1) Based on logarithmic least squares fit using data shown on Table I.

$r^2 = 0.919$

$a = 40.646$

$b = 0.684$

(2) Headship rate forecast has been adjusted to reflect the difference between 1980-81 actual and curve fit value.

Appendix C

HIGHLIGHTS OF THE 1979 APPLIANCE SATURATION SURVEY

1. The saturation level of the five major appliances (Ranges, Frost Free Refrigerators, Freezers, Automatic Washers, Dryers) has increased according to historical patterns and expectations.

2. The usage of electricity as a principle heating fuel increased from 14.9 percent in 1976 to 22.8 percent in 1979.

3. The saturation level of electric water heaters increased from 51.9 percent in 1976 to 64.8 percent in 1979.

4. The proportion of respondents who indicated a preference for electric space heating, if building or renovating their home, declined from 72.5 percent in 1976 to 40.6 percent in this survey.

5. Utilization of wood as a principle space heating fuel by itself or in combination with oil has taken a reversal in trend. Since 1968 the use of wood had declined from 22.9 percent to 6.5 percent of households in 1976. The 1979 survey shows that 9.5 percent of all households use wood as a principle heating fuel and another 9.6 percent use a combination oil/wood system for space heating. The survey results also indicate that 53.5% of electrically heated homes used wood as a back-up fuel.

6. Wood was used as a principle heating fuel in 13.1 percent of the households built in 1979. Electricity was used by 48.3 percent and combination of wood/oil by 18.1 percent of the households built in the same year.

7. The survey results show that there is a direct relationship between the amount of electricity used per household and the ownership of major appliances.

8. Nearly all (95.9%) of the respondents indicated that they were trying to reduce energy consumption in their home.

9. Nearly one in two (48.3%) of the households responded that they had added insulation in their house since 1975.

10. Saturation levels of major appliances as determined in each of the last five surveys are compared in Table I.

TABLE I

SATURATION SURVEY RESULTS FROM 1968, 1970, 1972, 1976, 1979

	Percent (%) Saturation Levels				
	1968	1970	1972	1976	1979
Heating Fuel					
Oil	73.9	81.1	85.3	78.6	55.7
Wood	22.9	14.6	7.8	6.5	9.5
Combination Oil/Wood	-	-	-	-	9.6
Electric	1.1	2.8	5.8	14.9	22.8
Other	-	-	-	-	2.6
Water Heating					
Oil	23.5	33.4	29.0	29.8	27.9
Electric	16.8	22.5	39.7	51.9	64.8
Propane	-	-	-	-	3.0
Other or None	42.8	27.4	27.6	18.3	4.4
Cooking					
Electric Range	44.9	54.9	65.7	78.2	85.7
Oil Range	18.3	16.8	13.9	8.9	3.0
Wood Range	24.1	14.6	10.2	6.6	3.9
Gas Range	8.6	8.5	8.5	6.3	4.8
Laundry					
Wringer or Spin Washer	59.3	57.0	49.0	36.9	20.6
Automatic Washer	30.0	35.3	44.1	58.4	71.3
Other or None	10.7	7.8	6.9	4.7	8.1
Electric Dryer	29.6	49.3	56.7	67.9	70.4
Other or None	69.5	49.5	43.3	32.1	29.6
Refrigerator-Freezer					
Combination Refrigerator-Freezer	17.0	17.8	19.2	21.7	45.3
Other Refrigerator	77.4	78.7	79.0	76.9	52.5
Other or None - Refrigerator	5.9	4.0	2.9	1.0	2.1
Separate Home-Food Freezer	26.7	31.5	35.8	46.7	53.9
Entertainment					
Television B & W	104.5	109.7	98.3	74.5	44.1
Television Color	-	9.0	20.9	55.6	74.6
Hi-Fi or Stereo System	33.8	43.0	49.6	67.0	61.7
Other Appliances					
Dishwasher	2.9	4.9	7.1	12.6	22.1
Air-Conditioner	2.8	4.2	5.6	7.5	5.8
Toaster Oven	-	-	-	-	23.4

Appendix D

CONVERSIONS TO ELECTRIC HEAT

The principle factors which are expected to contribute to conversion from other space heating fuels (mainly oil) to electric heating are:

(1) New Brunswick homeowners qualify for the federal government assistance ($800 maximum), under the National Energy Program, towards the cost of converting oil heating systems to electric heating.

(2) Recent innovations have led to the development of equipment which can be used to convert oil heating systems to electric without necessarily changing the service entrance size from 100 amperes to 200 amperes, thus lowering the overall conversion cost.

(3) The estimated cost to heat a residence with electricity is now, and will continue to be, competitive with oil.

The likelihood of conversion from oil to electric heating systems is dependent on the type and location of the dwelling. Customers in areas to be served by natural gas are likely to have different conversion characteristics as compared to those not in the gas service areas. The overall conversion rates are also expected to be higher for customers who need to replace worn out furnaces.

The succeeding pages show the expected level of conversions for all types of dwellings excluding apartments. Conversion from oil to electricity for an apartment building would result in a general service load and therefore not affect the residential sector sales. Estimates of non-apartment dwellings is based on Statistics Canada survey of Household Facilities and Equipment (Catalogue No. 64-202).

Four distinct groups of oil heated customers based on different conversion considerations, are identified below:

	Natural Gas Available	Furnace Replacement Needed	Number in Group
Group I	Yes	Yes	2,400/yr from 1981-82
Group II	No	Yes	2,400/yr from 1981-82
Group III	No	No	45,500 in 1981-82
Group IV	Yes	No	45,500 in 1981-82

The calculations for the number of households which fall into each of the above groups is shown below:

(1) Total no. of households in NB (1981)[1] = 222,000

(2) Percentage of households which are not apartments or flats. (Statistics Canada 64-202) = 77.5

(3) Total no. of households which are not apartments or flats, i.e., possible conversions = .775 x 222,000 = 172,000

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[1] Estimate based on billing information from NB Power, P.C.C., Saint John and Civic Hydro in Edmundston.

(4) No. of households in gas area = .50 x 172,000
(50% of N.B. served by gas) = 86,000

(5) No. of households in non-gas area
(3) - (4) = 86,000

(6) No. of households in gas area with
oil furnaces = .557 x (4) = 47,900

(7) No. of households in non-gas area with
oil furnace = .557 x 86,000 = 47,900

(8) No. of households in gas area needing
furnace replacement = .05 x (6) = 2,400
(Based on 20 year life cycle)

(9) No. of households in gas area not needing furnace replacement = (6) - (8) = 45,500

(10) No. of households in non-gas areas
needing furnace replacement = 2,400
= .05 x (7)

(11) No. of households in non-gas areas
not needing furnace replacement = 45,500
= (7) - (10)

The detailed calculations for year by year conversions are shown in Tables I and II. The total conversions, by year, are summarized in Table III.

TABLE I

CONVERSIONS FROM OIL TO ELECTRIC HEATING FURNACE REPLACEMENT REQUIRED

	No. of Households		Conversion %		No. of Conversions	
Year	Gas Area	Non-Gas Area	Gas Area(1)	Non-Gas Area(2)	Gas Area	Non-Gas Area
1981-82	2,400	2,400	20.0	40.0	480	960
1982-83	2,400	2,400	20.0	40.0	480	960
1983-84	2,400	2,400	20.0	40.0	480	960
1984-85	2,400	2,400	10.0	40.0	240	960
1985-86	2,400	2,400	10.0	40.0	240	960
1986-87	2,400	2,400	10.0	40.0	240	960
1987-88	2,400	2,400	10.0	40.0	240	960
1988-89	2,400	2,400	10.0	40.0	240	960
1989-90	2,400	2,400	10.0	40.0	240	960
TOTAL					2,880	8,640

Notes:

(1) In areas to be served by gas the conversion rate from oil to electric is decreased to 10% in 1984-85 when gas becomes a reality. The remaining households are not expected to switch to electricity for two reasons: (i) high cost of conversion and (ii) anticipation of gas pipeline and thus subsequent conversion to natural gas.

(2) In non-gas areas the 40% estimate for electric heat is based on the indication for heating fuel preference for new households (Appliance Saturation Survey 1979).

TABLE II

CONVERSIONS FROM OIL TO ELECTRIC HEATING
FURNACE REPLACEMENT NOT REQUIRED

	No. of Households (1)		Conversion % (2)		No. of Conversions	
Year	Gas Area	Non-Gas Area	Gas Area	Non-Gas Area	Gas Area	Non-Gas Area
1981-82	45,500	45,500	-	1.0	-	455
1982-83	45,500	45,045	-	1.0	-	450
1983-84	45,500	44,595	-	1.0	-	445
1984-85	45,500	44,150	0.5	1.5	225	660
1985-86	45,275	43,490	0.5	1.5	225	650
1986-87	45,050	42,840	0.5	1.5	225	640
1987-88	44,825	42,200	1.0	2.0	450	840
1988-89	44,375	41,360	1.0	2.0	445	830
1989-90	43,930	40,530	1.0	2.0	440	810
TOTAL					2,010	5,780

Notes:

(1) Does not include households built after fiscal year 1980-81.

(2) The conversion rate for households not needing furnace replacement is initially assumed zero in gas areas and 1.0% in areas which are not expected to be served by gas. Both rates are increased by 0.5% in 1984-85 and again in 1987-88 to allow for the expected improvement in the competitiveness of electricity prices in comparison to alternate heating fuels.

TABLE III

TOTAL CONVERSIONS FROM OIL TO ELECTRIC HEATING

Year	Need Furnace Replacement		Do Not Need Furnace Replacement		Total Conversions
	Gas Area	Non-Gas Area	Gas Area	Non-Gas Area	
1981-82	480	960	-	455	1895
1982-83	480	960	-	450	1890
1983-84	480	960	-	445	1885
1984-85	240	960	225	660	2085
1985-86	240	960	225	650	2075
1986-87	240	960	225	640	2065
1987-88	240	960	450	840	2490
1988-89	240	960	445	830	2475
1989-90	240	960	440	810	2450
TOTAL	2880	8640	2010	5780	19,310

CONVERSIONS TO AND FROM DOMESTIC HOT WATER HEATING

The conversion from oil to electric space heating is also likely to result in a simultaneous conversion to electric water heaters. However, 54.6% of the oil heated homes already have an electric hot water heater[1] and are thus not vulnerable. The remaining customers converting to electric heat can be separated into two distinct groups: (i) those requiring a furnace replacement and (ii) those converting to electric heat without the need for furnace replacement.

Customers opting for electric heat who do not already have electric hot water heaters can be expected to convert to electric water heating (as is the case with existing electric heat customers). Most of the customers converting to electric heat without the need for a replacement furnace are expected to use the special conversion heaters which do not require a change in the entrance size - a major expense in the conversion process. As this system is applicable to warm air systems - which are usually accompanied by an electric hot water heater - the conversion rate for this group is expected to be low. The total conversions to electric water heating are shown in Table IV.

With the expected availability of natural gas, in some areas of New Brunswick, by 1984, the conversion of oil heated homes, with electric water heaters, to natural gas will result in a loss of the existing electric hot water heaters. Estimate of the total water heaters lost due to natural gas are shown in Table V. The net changes in water heaters due to all types of conversion are summarized in Table VI.

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[1] Appliance Saturation Survey 1979; page 21.

TABLE IV

ADDITIONAL HOT WATER HEATERS

	CONVERSIONS TO ELECTRIC HEAT		CONVERSIONS TO ELECTRIC HOT WATER					
	Need for Furnace Replacement	No Need for Replacement	(1) Heating System Needs Replacement		(2) Heating System Does Not Need Replacement		No. of Additional Electric Hot Water Heaters	
Year	(1) No.	(2) No.	(3) %	(4)= (1)x(3)	(5) %	(6) (2)x(5)	(4) + (6)	
							Year	Cumulative
1981-82	1440	455	45.4	655	10.0	45	700	700
1982-83	1440	450	45.4	655	10.0	45	700	1400
1983-84	1440	445	45.4	655	10.0	45	700	2100
1984-85	1200	885	45.4	545	10.0	90	635	2735
1985-86	1200	875	45.4	545	10.0	85	630	3365
1986-87	1200	865	45.4	545	10.0	85	630	3995
1987-88	1200	1290	45.4	545	10.0	130	675	4670
1988-89	1200	1275	45.4	545	10.0	125	670	5340
1989-90	1200	1250	45.4	545	10.0	125	670	6010
TOTAL	11,520	7790		5235		775	6010	6010

Notes:

(1) 54.6% of oil heated customers currently own an electric hot water heater (Appliance Saturation Survey 1979, p.21). Thus only 45.4% of the conversions from oil to electric space heating will also result in additional electric water heaters.

(2) Customers not needing a furnace replacement are very likely to use electric heat insert that fits into warm air furnaces.

TABLE V

CONVERSIONS FROM ELECTRIC TO GAS WATER HEATING

Year	Number of Existing Homes ([1]) Converting from Oil to Gas	% With ([2]) Electric W.H.	No. With Electric W.H.	Cumulative No.([3]) of Conversions from Electric to Gas Water Heaters
1983-84	941	54.6	514	77
1984-85	3286	54.6	1794	372
1985-86	4894	54.6	2672	889
1986-87	5001	54.6	2731	1547
1987-88	4943	54.6	2699	2337
1988-89	4671	54.6	2550	3242
1989-90	4202	54.6	2294	4232

Notes:

([1]) Based on estimates contained in a study done for NB Power on the Feasibility of Natural Gas Distribution in New Brunswick.

([2]) NB Power Appliance Saturation Survey 1979, page 21.

([3]) Conversions are based on 15% rate in the first year of conversion to gas space heating. The rate is increased at 5% per year to a maximum of 60%.

TABLE VI

TOTAL ELECTRIC WATER HEATERS GAINED (LOST)

Year	Electric W.H. Gained Due to Conversion	Electric W.H. Lost Due to Conversion	Cumulative Net Gain (Loss)
1981-82	700	-	700
1982-83	1400	-	1400
1983-84	2100	(77)	2023
1984-85	2735	(372)	2363
1985-86	3365	(889)	2476
1986-87	3995	(1547)	2448
1987-88	4670	(2337)	2333
1988-89	5340	(3242)	2098
1989-90	6010	(4232)	1778

Number/
Numéro

2

LOAD FORECAST

1982-97

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

PREPARED BY:

FORECAST SECTION/
STRATEGIC DEVELOPMENT

SEPTEMBER, 1982

ABSTRACT

The 1982 forecast procedure is similar to that used in 1981 with the exception that this forecast has incorporated the effects of current and forecast economic conditions, particularly on the General Service and Industrial sales classifications.

The longer term results of the two forecasts are only slightly different. This forecast results in 2% lower energy sales in the tenth year, i.e. the fiscal year 1991/92. Although the load level is consistently below that in the previous forecast, the overall growth rate during the early years of this forecast is higher. This higher growth rate results primarily from an allowance for the current low energy requirements of existing industry returning to normal by 1986. Specific key elements in this forecast are:

(1) The current fiscal year (1982/83) in-province energy is forecast at 2.8% below the previous year actual. This is due mainly to the effect of prevailing economic conditions which have particularly affected the Industrial sales. This 1982 forecast allows for a gradual upturn of the economy with the recovery of these Industrial sales to normal by 1986.

(2) Subsequent to the 1981 forecast a major addition was announced by a customer in the pulp and paper industry. The increase was larger than our allowance for industrial development and has had the effect of causing our Industrial Transmission sales to be slightly higher than in the previous forecast.

(3) Historical population estimates and projections have now been revised on the basis of recently released 1981 census results. Based on census counts the number of people in New Brunswick are now estimated to be 18,000 less than that for

the same period in the 1981 load forecast. Over the next ten years the population is now forecast to grow by 9000 fewer people compared to the growth projected in the 1981 load forecast. The reduction in future population growth is due to lower fertility rate projections. The impact of lower population data is reflected in a slight reduction in General Service sales.

(4) Based on the findings of NB Power's November 1981 Appliance Saturation Survey the appliance ownership and kwh use data was updated in this 1982 forecast. The findings of this survey were in line with previous projections thus having little effect on the overall forecast.

(5) Forecast of conversions from oil to electric space heating have been updated to incorporate the customer intentions indicated in the 1981 Appliance Saturation Survey and the actual experience related to such conversions, since the inception of the Canada Oil Substitution Program in October 1980. On an average the provincial conversions are now forecast to be 2600 per year compared to 2100 in the 1981 forecast. The net effect of this additional 500 conversions per year represents some 8.0 gwh per year increase in residential sales. This corresponds to 0.1% of the current level of total in province energy.

(6) Effects of natural gas are now forecast to be felt by the fiscal year 1984/85, a delay of one year from the previous forecast. This one year delay has meant an additional 20 gwh of sales in 1983/84, reflecting about 0.2% of the total energy forecast for that period. Further delays in the availability of natural gas will have similar effects on total in-province energy supply.

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SUMMARY OF RESULTS

The results of this forecast indicate a 10 year growth rate of 3.5% for in-province net energy supply and a 3.0% rate for the corresponding peak hourly demand.

The 3.5% energy growth rate as shown in Table I results from: (i) the addition of new loads (3.3% growth rate) and (ii) the recovery of the 1981/82 load reductions in the Industrial sales (0.2% growth rate). This means the real growth rate in energy sales is 3.3%. The corresponding rate for the first ten years of the 1981 forecast was 3.5%.

The 3.0% peak hourly demand growth rate shown in Table I is abnormally low. This is due to the unusually cold weather conditions which occurred at the time of the 1981/82 system peak. It is estimated that the 1981/82 peak demand of 1587 MW was some 50 MW above normal. When this adjustment is made, the 10 year annual growth for peak demand is 3.4%. The corresponding rate for the first ten years of the 1981 forecast was 3.7%

By the end of the ten year period (1991/92) the energy supply is 2% below the 1981 forecast with demand some 3.7% below. This larger decrease in demand in comparison to energy results primarily from a refinement made in the method of forecasting peak demand. The other factor which contributes to this is the resulting higher proportion of high load factor industrial sales by this point in time.

The system net energy (GWH) and the peak hourly demand (MW) forecasts prepared in 1981 and 1982 are shown for each fiscal year in Table I.

The table also compares the 10 year and total period growth rates for the two forecasts. The actual growth pattern over the past five years for system net energy and peak hourly demand as well as the results of the 1981 and 1982 forecasts are depicted graphically in Figure I.

Principal results for the tenth year of the 1981 and 1982 forecasts, i.e. fiscal years 1990/91 and 1991/92 respectively, which include sales to each customer classification, system net energy and peak hourly demand are shown in Table II. The corresponding actual values for the fiscal years 1980/81 and 1981/82 and the average annual growth rates, for the first ten years of the two forecasts, based on these actual values are also shown in Table II.

TABLE I

COMPARISON OF 1981 AND 1982 LOAD FORECASTS

	System Net Energy (GWH)		Peak Hourly Demand (MW)	
	1981 Forecast	1982 Forecast	1981 Forecast	1982 Forecast
1980/81	8,311*	-	1,502*	-
1981/82	8,732	8,375(Actual)	1,591	1,587 (Actual)
1982/83	9,391	8,137	1,690	1,579
1983/84	9,724	8,829	1,754	1,715
1984/85	10,041	9,653	1,815	1,765
1985/86	10,333	10,086	1,872	1,821
1986/87	10,618	10,494	1,930	1,875
1987/88	10,906	10,757	1,988	1,929
1988/89	11,184	11,023	2,045	1,982
1989/90	11,468	11,279	2,102	2,033
1990/91	11,754	11,543	2,160	2,085
1991/92	-	11,804	-	2,137
10 Year Growth Rate (%/year)	3.5	3.5	3.7	3.0
1991/92	12,043	-	2,220	-
1992/93	12,339	12,067	2,281	2,189
1993/94	12,639	12,337	2,343	2,243
1994/95	12,940	12,608	2,406	2,296
1995/96	N.A.	12,880	N.A.	2,351
1996/97	N.A.	13,160	N.A.	2,405
Total Period Growth Rate (%/year)	3.2	3.1	3.4	2.8

* Values are those used in the 1981 load forecast and differ slightly from the 1980/81 actuals, since actual data was not available at the time of the 1981 forecast.

COMPARISON OF 1981 AND 1982 FORECASTS

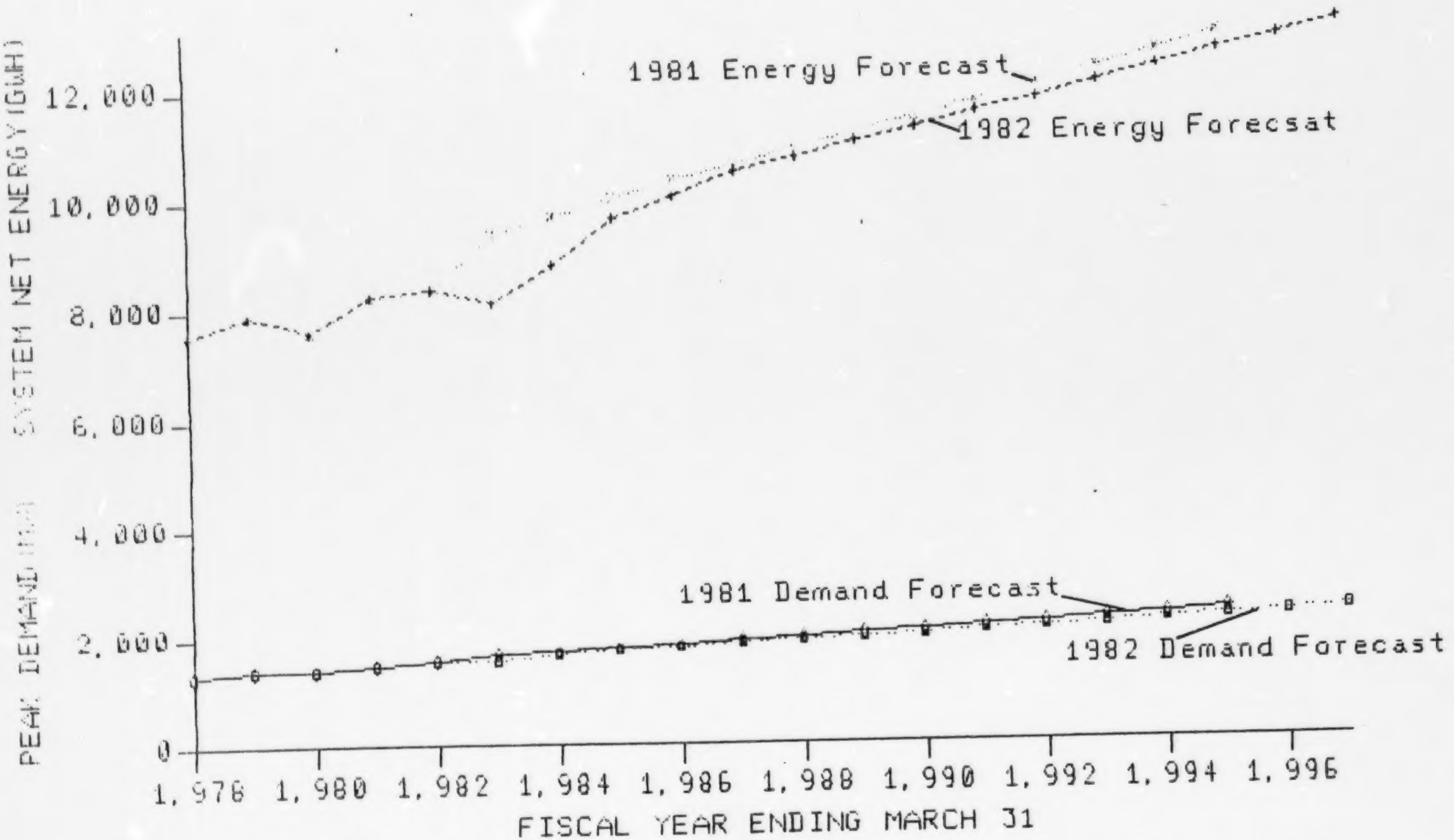


FIGURE I

TABLE II

COMPARISON OF PRINCIPAL RESULTS FROM 1981 AND 1982 FORECASTS

					Ten Year Average Annual Growth Rate(%)	
	1980/81 (Actual)	1981/82 (Actual)	1981 Forecast for 1990/91	1982 Forecast for 1991/92	1980/81 -1990/91 1981 Forecast	1981/82 -1991/92 1982 Forecast
Residential Sales (GWH)	2,057	2,119	2,844	2,814	3.3	2.9
General Service Sales (GWH)	1,165	1,169	1,553	1,499	2.9	2.5
Street Lights Sales (GWH)	50	51	68	62	3.1	2.0
Industrial Distribution Sales (GWH)	329	293	539	406	5.1	3.3
Industrial Transmission Sales (GWH)	3,301	3,248	4,872	5,106	4.0	4.6
Wholesale for Resale (GWH)	640	659	831	875	2.6	2.9
Total Sales (GWH)	7,564	7,538	10,707	10,762	3.5	3.6
Losses (GWH)	769	837	1,047	1,042	3.1	2.2
System Net Energy (GWH)	8,311	8,375	11,754	11,804	3.5	3.5
Annual Load Factor (%)	62.8	60.2	61.6	63.1	-0.2	0.5
Peak Hourly Demand (MW)	1,502	1,587	2,160	2,137	3.7	3.0

* Values are those used in the 1981 load forecast and may differ slightly from the 1980/81 actuals, since the actual data was not available at the time of the 1981 forecast.

1982 LOAD FORECAST

INTRODUCTION

This document presents a forecast of the demand for electrical energy by the in-province customers of the New Brunswick Electric Power Commission (henceforth referred to as NB Power) for the period 1982 through 1997. It is intended to provide the basis for the financial and system planning processes at NB Power.

The forecast of energy sales is prepared for six distinct customer classifications. These classifications are:

1) Residential - includes households, farms, churches, and seasonal customers.

2) General Service - includes retail outlets, schools, hospitals, offices, motels/hotels, service stations.

3) Industrial Distribution - includes wood related processing (sawmills), metal fabricating, pumping stations, fish processing.

4) Street Lights, - includes regular street lights, dusk to dawn lights, railroad crossing signals, traffic lights.

5) Wholesale for Resale - includes all of the above classifications as supplied to the cities of Saint John and Edmundston.

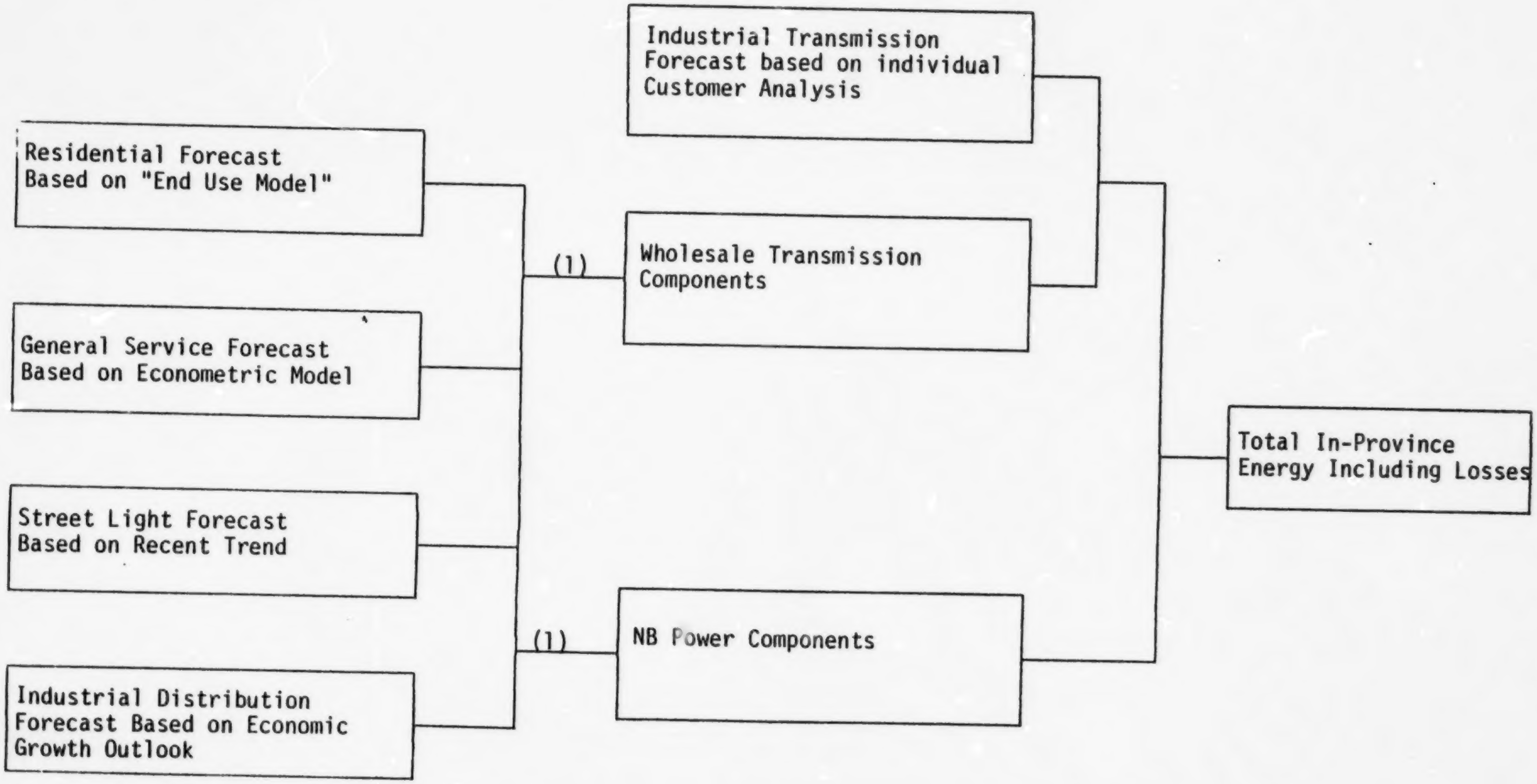
6) Industrial Transmission - includes pulp and paper industry, mining and smelting, petroleum and chemical products industries.

Two principal reasons for preparing a separate forecast for each of the above classifications are: (i) the requirements of each customer classification are affected to a different degree by the various economic, demographic and other factors which influence electrical energy sales, (ii) the forecast of each customer classification is needed for financial and system planning. Forecast methodology for each customer classification is outlined in Figure II.

The succeeding sections of this document include a brief historical perspective, an overview of the forecast methodology, the principal results and their comparison to the previous forecast for each of the six customer classifications. In addition the report includes sections on total province system net energy, a monthly breakdown of the annual energy forecast and the peak hourly demand for each month.

FORECAST METHODOLOGY

FIGURE II


Industrial Transmission Forecast based on individual Customer Analysis
Residential Forecast Based on "End Use Model"
(1)
Wholesale Transmission Components
General Service Forecast Based on Econometric Model
Total In-Province Energy Including Losses
Street Light Forecast Based on Recent Trend
(1)
NB Power Components
Industrial Distribution Forecast Based on Economic Growth Outlook

(1) The total provincial sales for each of the four classifications, i.e. Residential, General Service, Street Lights and Industrial Distribution, is allocated to Wholesale and NB Power components on the basis of historical relationships.

RESIDENTIAL CLASSIFICATION

The increased use of electric space and water heating in the early and mid 70's resulted in a rapid growth of the electrical energy sales to NB Power's residential customers - an average annual rate of 18.2% between the fiscal years 1971/72 and 1976/77. As a result the residential share of NB Power's total provincial electrical energy sales increased from 19.4% to 27.9% over that time period. The average annual growth in sales to Residential classification has been 3.2% between 1976/77 and 1981/82 and the Residential proportion of the total sales has remained steady at about 28 percent.

The principal reasons for the decline in growth rate since 1977 are considered to be, (i) resurgence of wood as a space heating fuel, especially as a supplementary fuel in electrically heated homes,[1] (ii) lower growth in population and therefore households in New Brunswick as compared to the first half of the seventies[2]. Energy conservation efforts which have become popular in the past few years are also expected to have contributed to the lower growth rate for residential electrical sales since 1977.

The residential electrical energy needs are dependent on several interrelated variables. Those considered in this forecast are:

- growth rate for population, especially the population over fifteen (15) years of age which is capable of forming independent households;
- average number of persons in a household;
- ownership and use of electrical appliances, including space and water heating equipment;

- weather effect on heat sensitive sales;
- the relative price and availability of alternate energy sources;
- the current trends and potential for conservation;
- policies of the Federal and/or Provincial governments which encourage, through grants or incentives, the use of one source of energy over another to attain a desired energy balance;
- technological developments.

This forecast has attempted to assess and incorporate the current and expected impact of the above variables.

FORECAST METHODOLOGY

The provincial Residential forecast is divided into two groups, seasonal and regular (year-round) customers. The regular customers account for almost 99% of the sales to this classification. This group's electrical energy was forecast by an "end use" model. The model is based on determination of the quantity of electricity used by each consuming source, e.g., space heating, water heater, refrigerator, freezer, stove. Three major components of the end use model applied to this forecast are:

(1) Number of regular residential customers
(2) Appliance saturation levels (number and type of electrical appliances in use per household)
(3) Appliance kwh use (the average amount of electricity required to operate each major household appliance).

The model can be stated as:

ENERGY (KWH) = REGULAR RESIDENTIAL CUSTOMERS x APPLIANCE SATURATION LEVEL x APPLIANCE USE (KWH)

The forecast of seasonal customers' requirements is based on the extrapolation of their historical consumption pattern.

The major components of the forecast model for the regular residential customers are described below.

1) Regular Residential Customers

Between the fiscal years 1971/72 and 1981/82 the population of New Brunswick grew from 636,400 to 698,300 - an average annual rate of 0.9%. The regular residential customers grew from 163,068 to 224,327 over the same time period - an average annual growth rate of 3.2%. More than threefold increase in the growth rate for regular residential customers as compared to the population growth rate reflects a decreasing household size.

The future number of regular residential customers, in the province are dependent on both the provincial population and persons per household. Population changes are dependent on:

(a) the fertility rate (births per 100 of female population between the ages of 15 and 49)

(b) the mortality rate (deaths per 1000 people)

(c) the migration rate (the number of people migrating into or out of the province).

Fertility and migration rates are the more significant and difficult to project components of a population projection. Both factors are influenced by social and economic conditions. Mortality rates on the other hand are relatively steady for different age groups and reliable estimates of survivors for each age group can be obtained by applying the appropriate rate.

Since we are dealing with a fifteen year forecast, the difficulty in forecasting fertility rates is overcome in this forecast by basing future number of regular residential customers on the proportion of population over fifteen years of age i.e. only the people already born are considered capable of being regular residential customers within the forecast period.

The regular residential customer forecast is thus based on the projection of population over fifteen and forecast of headship rate-percentage of people over the age of fifteen who will be regular residential customers.

Projection of population over fifteen is based on group survival technique in which the forecast survival rate[3] for each age group was applied to the existing population. The net migration was assumed to be zero over the forecast period. Projection of population over fifteen and total population along with underlying assumptions are discussed in Appendix A. Headship rate forecast is based on recent historical trends. It is discussed in more detail in Appendix B. Historical estimates and projected values of population over the age of fifteen, headship rate and number of regular customers are shown in Table III.

TABLE III

		Col. (1)	Col. (2)	$\frac{\text{Col. (1)} \times \text{Col. (2)}}{100}$
Fiscal Year		Polulation Over Age 15 (1)	Headship Rate* Estimates (2)	Number of Regular Customers
1971-72	Actual	434,200	37.556	163,068
1972-73		442,800	38.505	170,499
1973-74		452,100	39.629	179,163
1974-75		462,200	40.648	187,875
1975-76		476,100	40.905	194,749
1976-77		487,600	41.647	203,073
1977-78		496,600	42.141	209,274
1978-79		505,100	42.452	214,426
1979-80		513,100	42.549	218,317
1980-81		519,700	42.684	221,828
1981-82		525,400	42.696	224,327
1982-83	Forecast	532,900	42.799	228,027
1983-84		539,800	42.900	231,574
1984-85		546,400	42.942	234,624
1985-86		553,100	42.979	237,666
1986-87		559,900	43.013	240,812
1987-88		566,300	43.043	243,735
1988-89		572,100	43.072	246,403
1989-90		577,400	43.098	248,801
1990-91		582,800	43.122	251,303
1991-92		587,800	43.145	253,576
1992-93		592,400	43.166	255,679
1993-94		596,500	43.186	257,568
1994-95		600,300	43.205	259,329
1995-96		604,100	43.208	261,091
1996-97		607,700	43.228	262,769

* Percentage of people over fifteen (15) years of age who will be regular residential customers.

(1) See Appendix A.

(2) Actual headship rates for 1971/72 to 1981/82 obtained by expressing number of regular residential customers as a percent of population over fifteen. See Appendix B for forecast of headship rate.

2) Applicance Saturation Levels

The amount of electricity consumed by a household depends on the type and number of electrical appliances in use. The current and future appliance saturation levels - percentage of households having particular appliances - are therefore important elements of the residential forecast.

Estimates of current saturation levels of appliances were obtained from the 1981 Appliance Saturation Survey[4]. Highlights of the survey are given in Appendix C. The saturation levels for all major appliances - excluding electric space and water heating - were projected on the basis of historical trends. Projections in our 1981 Load Forecast, which were based on trend analysis of the saturation survey data up to 1979, were in line with the results of the 1981 saturation survey.

Electric space and water heating account for more than one-half of the current total residential electrical consumption. Between 1971 and 1981 the provincial saturation levels for these two applications have risen rapidly - a change from 2.1% to 23.5% for space heating and from 36.9% to 66.1% for water heating. The future growth for electric space and water heating is expected to result from (a) the penetration into new construction and (b) the conversion of existing homes from alternate fuels - mainly oil - to electricity.

(a) Penetration into New Construction:

Based on the findings of the 1981 Appliance Saturation Survey and consideration of the choices available it is forecast that prior to natural gas becoming an alternative some 60% of the new customers in the province will use electricity by itself or in combination with other fuels. The remaining customers will therefore install wood, propane, oil or some combination of these fuels, with solar heating as a possible supplement, as their heating source. Electricity will penetrate a larger (80%) proportion of the water heating market for new customers.

The forecast effect of natural gas on the residential forecast is based on the following considerations:

(1) Natural gas will affect customer decisions on space and water heating beginning in the fiscal year 1984/85.

2) Natural gas will be available to one half of all the residential customers within the province. In new residential construction - within the gas service area - 75% of the customers will choose natural gas for space heating and 60% will install gas water heaters.[5]

3) Electricity will capture 60% of the space heating and 80% of water heating in the new residential market outside of the gas service area and the same percentage of the non-gas homes within the gas service area. No existing electric space heating customer will convert to natural gas.

The net effect of these considerations is that natural gas will reduce the forecast penetration rate for electricity in new residential space heating market from 60% to 37.5%. Penetration into the water heating market will also drop from 80% to 56% by the fiscal year 1984/85.

(b) Conversion of Existing Homes:

The ultimate saturation levels of electric space and water heating will also be affected by existing homes switching from oil to electricity as a primary heating fuel. The conversions from oil to electric space heating are expected due to: (1) improved economics of electric heating in relation to oil and (2) federal government grant (maximum of $800) for substitution of oil by alternate fuels including electricity.

The average number of conversions from oil to electric space heating is forecast at about 2600 per year over the next ten years. The net gain in water heaters due to conversion is forecast at about 750 per year. The basis for conversion estimates is discussed in Appendix D.

The saturation levels for space and water heating were determined on the basis of the factors relating to penetration rates, natural gas effects and off-oil conversions. The forecast saturation level for these two applications and other electrical appliances are shown in Table IV.

TABLE IV

PROJECTIONS OF APPLIANCE SATURATION LEVELS*

Type of Appliance	1981-82(1)	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Electric Heating	23.5	25.6	27.4	28.6	29.8	30.9	32.0	33.1	34.1	35.1	36.1
Electric Water Heater	66.1	66.5	66.9	67.0	67.0	67.1	67.2	67.3	67.5	67.6	67.8
Electric Range	89.1	90.5	91.5	92.4	93.2	94.0	94.8	95.5	96.2	96.9	97.6
Refrigerator	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Freezer	58.6	60.1	61.2	62.1	63.1	63.9	64.6	65.4	66.1	66.8	67.5
Clothes Washer (Auto & Wringer)	85.7	85.7	85.6	85.4	85.3	85.2	85.1	85.0	84.9	84.8	84.7
Electric Clothes Dryer	71.9	72.5	73.6	74.1	74.6	75.1	75.6	76.1	76.6	77.1	77.6
Television (B & W & Color)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
Air-Conditioner	5.5	5.9	6.3	6.7	7.1	7.6	8.1	8.7	9.3	9.9	10.6
Dishwasher	27.5	29.3	30.3	31.2	32.0	32.8	33.5	34.2	34.9	35.6	36.3
Lighting	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Saturation levels expressed as percent.

(1) Based on 1981 Appliance Saturation Survey Results.

3) Appliance Use

In addition to forecasting the number of regular residential customers and appliance saturation levels the contribution of each appliance to the average annual household consumption is a required input to the "end use" model used for the residential forecast.

On the basis of the data collected for the 1981 Appliance Saturation Survey the average annual consumption for space heating equipment in the fiscal year 1981/82 was calculated to be 13,400 kwh per year. To allow for the continuing effects of conservation and better insulation in future, the average annual space heating consumption was decreased by 0.5% each year from 13,400 to 12,430 kwh/yr over the forecast period.

Water heaters are second only to space heating in terms of annual use per unit and their contribution to average household consumption. They account for nearly twenty-five (25) percent of the current total residential electrical energy needs. An average annual consumption of 3,960 kwh, decreasing by 0.5% per year to allow for the effects of conservation has been used for electric water heaters. This usage is based on data collected for the 1981 Appliance Saturation Survey and the results of a CEA[6] study on water heaters.

A range of the average consumption, for each of the other major appliances, was established on the basis of data used by other electrical utilities. The values applicable to New Brunswick were determined by reconciling historical appliance saturation levels and estimated average appliance consumption for each year with the actual aggregated household weather adjusted[7] consumption for the corresponding period. Data from 1981/82 is used to illustrate this process in Table V.

Consumption level forecast for some of the appliances has been adjusted to allow for the expected changes in trend, e.g., refrigerator and freezer consumption is increased at 1% per year to allow for the transition from manual to automatic defrost. Revised consumption levels for all major appliances and their contribution towards average household consumption for the fiscal year 1991/92 are also shown in Table V.

Forecast Computations

The future housing stock and the contribution of each appliance towards average annual household consumption was calculated through a specially developed computer program. This program ensures the accuracy of the numerous calculations required and provides an easy method for assessing the sensitivity of the forecast to changes in key variables. The "end use" technique for forecasting regular residential customers sales was applied to the fiscal year 1991/92 and the growth rate at that point in time were used to forecast sales for the balance of the forecast period.

Seasonal customers e.g. summer cottages are also classified as Residential Customers at NB Power. The electrical consumption of these customers, which is about one (1) percent of the total residential sales, was forecast by extrapolating historical trends. Seasonal sales and regular residential customers sales forecasts were added to obtain the total Residential classification electrical energy sales forecast.

NB Power does not retail electricity to all of the residential customers in the province. The portion of the total forecast sales expected to be retailed by the municipal utilities in Saint John and Edmundston was determined on the basis of historical data. This amount was allocated as residential portion of the forecast for the Wholesale classification.

TABLE V

END USE ESTIMATES FOR RESIDENTIAL ELECTRICAL CONSUMPTION

Electrical Appliance or Equipment	1981-82 Saturation Level	Annual (2) Appliance Consumption (KWH)	Contribution to Average Household Consumption (KWH)	% of Total	1991-92 Saturation Level	Annual (2) Appliance Consumption (KWH)	Contribution to Average Household Consumption (KWH)	% of Total
(1) Heating System	23.5	13,400	3,149	30.0	36.1	12,745	4,601	37.3
(2) Water Heater	66.1	3,960	2,618	25.0	67.8	3,767	2,554	20.7
(3) Cooking Range	89.1	1,176	1,048	10.0	97.6	1,064	1,038	8.4
(4) Refrigerator	100.0	1,020	1,020	9.7	100.0	1,127	1,127	9.1
(5) Freezer	58.6	1,020	598	5.7	67.5	1,127	761	6.2
(6) Clothes Washer	85.7	60	51	0.5	84.6	60	51	0.4
(7) Clothes Dryer	71.9	900	647	6.2	77.6	900	698	5.7
(8) Television (B & W + Color)	100.0	384	384	3.7	100.0	314	314	2.5
(9) Air Conditioner	5.5	500	28	0.3	10.6	500	53	0.4
(10) Dishwasher	27.5	360	99	0.9	36.3	360	131	1.1
(11) Lighting	100.0	600	600	5.7	100.0	600	600	4.9
(12) Miscellaneous	100.0	240	240	2.3	100.0	391	391	3.2
(13) Total			10,482	100.0			12,319	100.0
(14) Actual Average (1) Household Consumption 1981-82			10,499					
(15) Difference Due to Weather (13)-(14) 1981-82			17					

Notes:

(1) Actual Average Consumption for 1981-82 is determined by dividing the total residentail sales in 1981-82 by the number of customers at the mid point of the fiscal year.
Actual average consumption per customer in 1981-82 = $\frac{2,355,119,000\ \text{KWH}}{224,323\ \text{customers}}$ = 10,499 KWH/customer.

(2) The annual average appliance consumption and any changes in the future is based on estimates made by NB Power and other utilities.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 2.9% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate in the first ten years of the previous (1981) Residential forecast was 3.3 percent.

The average annual growth rate of 4.3% in the first two years is higher than the ten year average of 2.9%. This reflects the larger number of oil to electric space heating conversions expected in these two years. The effects of natural gas affects the growth rate forecast from the third year (1984/85) onwards. The results of this forecast are summarized in Table VI.

TABLE VI

FORECAST AND HISTORY OF RESIDENTIAL SALES (GWH)

Fiscal Year		Total Sales New Brunswick	Breakdown of the Total Sales	
			Wholesale for Resale	NB Power Portion
1971-72	Actual	935	150	785
1972-73		1073	162	911
1973-74		1251	179	1072
1974-75		1487	203	1284
1975-76		1797	243	1554
1976-77		2084	275	1809
1977-78		2183	278	1905
1978-79		2266	256	2010
1979-80		2229	254	1975
1980-81		2312	255	2057
1981-82		2382	263	2119
1982-83	Forecast	2495	282	2213
1983-84		2599	294	2305
1984-85		2675	302	2373
1985-86		2751	311	2440
1986-87		2826	319	2507
1987-88		2900	328	2572
1988-89		2971	336	2635
1989-90		3037	344	2694
1990-91		3105	351	2754
1991-92		3172	358	2814
1992-93		3242	366	2876
1993-94		3316	375	2941
1994-95		3389	383	3006
1995-96		3464	391	3073
1996-97		3542	400	3142

FOOTNOTES

(1) NB Power 1981 Appliance Saturation Survey.

(2) Census data indicates a population growth rate of 1.2% between 1971 and 1976 and 0.6% between 1976 and 1981.

(3) Survival rate projections provided by the Economics and Statistics Branch, Department of Finance, Province of New Brunswick.

(4) NB Power 1981 Appliance Saturation Survey.

(5) Based on the data collected for "Study on Natural Gas Distribution in the Province of New Brunswick" by Crandall Energy Consultants Ltd.

(6) Canadian Electrical Association Research Study: Determination of the Energy Required to Produce Domestic Hot Water; Project 913 U-160.

(7) The residential electrical consumption is sensitive to weather as nearly one in four customers are electrically heated and an additional ten percent of the customers use electricity as a supplementary heating source. Reconciliation of historical appliance saturation levels and annual appliance consumption was done after adjusting the latter to "normal" weather conditions.

GENERAL SERVICE CLASSIFICATION

General Service sales by NB Power grew at an average annual growth rate of 8.0% between 1971/72 and 1976/77. The growth rate since 1976/77 has dropped to 4.6% per year.

The higher growth between 1971/72 and 1976/77 can be attributed mainly to (i) increased use of electricity for space heating in the commercial, institutional and governmental sectors of the General Service market, (ii) high population growth at an average rate of 1.2% per year and, (iii) the economic prosperity evident from annual growth of 5.0% in Real Domestic Provincial Product.

The slower growth in economy between 1976/77 and 1981/82, with the Real Domestic Provincial Product growing at about 1% per year, and the slower growth in population - 0.5% per year - are considered to be the principal reasons for the slower growth in electrical sales over the last five years to the customers in General Service classification. Conservation measures that have become popular, as a result of increasing energy prices, in the past few years are also considered responsible for the deceleration in the growth rate for this classification. We did not develop a quantitative assessment of the impact of conservation on the sales to this classification. However our contacts with some of the large institutional customers indicate that specific conservation measures have been in effect and have yielded positive results in the recent years.

FORECAST METHODOLOGY

The customers in this classification have a very wide consumption range, varying from a few hundred kwh to over one million kwh per month. The nature of operations and therefore the end use characteristics are also quite diverse. The forecast of General Service sales using an "end use" technique, which could analyze the requirements of customers with similar usage characteristics, is not possible at this time due to unavailability of necessary data. Work has started at both the national level by the Canadian Electrical Association and at the local level by NB Power, to better understand the end use of electricity for customers in this classification.

In our analysis of General Service sales we have attempted, through time series and econometric models, to correlate historical General Service electrical energy with population and economic data. Key findings of our analysis indicate that demand for services provided by the customers in this classification and consequently their requirements for electrical energy are related to per capita personal disposable income and the total population.

An econometric model[1] was developed as a result of our analysis and findings. The model defines annual General Service sales per capita as a dependent variable while per capita real disposable income was used as the independent variable. Utilization of this model to forecast General Service sales required estimates of future levels of per capita personal disposable income and population.

Per capita growth in real disposable income is based on the potential for future growth in real domestic provincial product and attempts to take into account the impact of current federal government policies on wage restraint as well as the intended freeze of the federal transfer payments to New Brunswick in real dollars i.e. growth in future payments will match inflation rate[2].

Total provincial population was projected by using the group survival technique in which the forecast survival rate[3] for each age group was applied to the existing population. Births based on fertility rate forecast[4] were added to the forecast population while net migration was assumed to be zero over the next fifteen years. The population projection and its underlying assumptions are discussed in more detail in Appendix A.

The long term growth in per capita real personal disposable income is forecast to be 1.65% per year. However in the short term, i.e. the next three years, it is assumed that per capita real personal disposable income will grow at 0.0, 0.5 and 0.9% respectively.

The results of this forecasting procedure were compared to the results from the previous forecasting model, which used population as the independent variable. The population model was however updated to incorporate revised history and projection of population based on the 1981 census. The results by the year 1991/92 differ by only 57 gwh and the overall annual growth rate for the econometric model is 3.0% compared to 3.2% for the population model. However since the econometric model is able to account for both population and economic conditions, it is felt that it can better represent the future. It is also considered to be more useful in reflecting the effects of changes in economic forecasts.

One other principal factor that would impact the sales to this customer classification, particularly the new customers, is the expected extension of natural gas pipeline to New Brunswick. Therefore the forecast prepared on the basis of the econometric model was modified to incorporate the forecast effects of natural gas. This effect is shown in Table VII and was based on the following considerations:

(1) Natural gas will affect customer decisions on space and water heating beginning in the fiscal year 1984/85.

(2) Eighty (80) percent of the new General Service customers will be in the gas service area.

(3) The electric space and water heating portion of the sales to these customers is estimated at seventeen (17) percent of the total sales to this classification.[5]

(4) Natural gas will not displace existing electric space heating. However it will displace all of the potential space and water heating related loads for new customers in the gas service area.

(5) Approximately 3 gwh of the existing General Service load is estimated to be lost each year due to conversion, to natural gas, of electric water heaters in existing oil space heated buildings which convert to natural gas.

Forecast Computations

The computer program used in the residential section incorporates the results of the General Service econometric model. The results of the econometric model, which is complete by itself, are derived by a separate computer program.

A portion of the General Service electrical energy is retailed by municipal utilities in Saint John and Edmundston. This portion of the sales was determined on the basis of historical trends and allocated to General Service part of the Wholesale classification.

TABLE VII

FORECAST AND HISTORY OF GENERAL SERVICE SALES (GWH)

Fiscal Year	General Service Sales*	Cumulative Effect of Gas Incursion	Total Sales (New Brunswick)
1971-72	Actual 707	-	707
1972-73	799	-	799
1973-74	895	-	895
1974-75	997	-	997
1975-76	1124	-	1124
1976-77	1209	-	1209
1977-78	1267	-	1267
1978-79	1347	-	1347
1979-80	1406	-	1406
1980-81	1461	-	1461
1981-82	1475	-	1475
1982-83	Forecast 1498	-	1498
1983-84	1530	-	1530
1984-85	1568	(9)	1559
1985-86	1630	(22)	1608
1986-87	1687	(34)	1653
1987-88	1746	(47)	1699
1988-89	1804	(57)	1747
1989-90	1864	(72)	1792
1990-91	1924	(84)	1840
1991-92	1987	(97)	1890
1992-93	2047	(110)	1937
1993-94	2109	(123)	1986
1994-95	2170	(135)	2035
1995-96	2232	(146)	2086
1996-97	2296	(157)	2139

* Actual values up to fiscal year 1981/82 and forecast based on a econometric model from 1982/83 onwards. Forecast values may differ slightly from the results of the econometric model due to rounding procedure used in the computer program.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 2.5% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate for the first ten years of the previous (1981) General Service forecast was 2.9 percent.

The average annual growth rate in the first three years of the forecast is 1.9% per year reflecting the current depressed state of the economy and allowing for a gradual recovery by the fiscal year 1985/86. The results of this forecast are summarized in Table VIII.

TABLE VIII

BREAKDOWN OF GENERAL SERVICE SALES (GWH)

			Breakdown of the Total Sales	
Fiscal Year		Total Sales New Brunswick	Wholesale for Resale	NB Power Portion
1971-72	Actual	707	167	540
1972-73		799	181	618
1973-74		895	200	695
1974-75		997	222	775
1975-76		1124	252	872
1976-77		1209	274	935
1977-78		1266	282	984
1978-79		1347	275	1072
1979-80		1406	288	1118
1980-81		1461	296	1165
1981-82		1475	306	1169
1982-83	Forecast	1498	310	1188
1983-84		1530	317	1213
1984-85		1559	323	1236
1985-86		1608	333	1275
1986-87		1653	342	1311
1987-88		1699	352	1347
1988-89		1747	362	1385
1989-90		1792	371	1421
1990-91		1840	381	1459
1991-92		1890	391	1499
1992-93		1937	401	1536
1993-94		1986	411	1575
1994-95		2035	421	1614
1995-96		2086	432	1654
1996-97		2139	443	1696

FOOTNOTES

(1) WONG, Hon-Po: General Service Forecast, 1982-2001, NB Power.

(2) WONG, Hon-Po: General Service Forecast, 1982-2001, NB Power, pp. 9-20.

(3) Survival rate projections provided by the Economics and Statistics Branch, Department of Finance, Province of New Brunswick.

(4) Fertility rate projections provided by the Economics and Statistics Branch, Department of Finance, Province of New Brunswick.

(5) Based on our analysis of the billing records for General Service customers for the fiscal years 1980/81 and 1981/82.

INDUSTRIAL DISTRIBUTION CLASSIFICATION

This classification, like General Service, encompasses customers with a wide diversity in their size and nature of operations. Nearly one half of the approximately 1400 customers and about 70 percent of the sales are related to manufacturing sector[1]. Another important component of this classification is pumps for water and sewage systems accounting for about 15 percent of the total sales in the fiscal year 1981/82.

Between the fiscal years 1971/72 and 1981/82 the sales to Industrial Distribution customers grew at an average annual rate of 4.6%. The growth rate however did not follow the Residential and General Service pattern of large increases in the first half of the decade and lower growth rates in the latter part. The annual growth rate for this classification fluctuated between -6.9 and 10.1 percent.

In the fiscal year 1981/82 the sales to this customer classification declined by 6.9% compared to the year 1980/81. This significant reduction was in contrast to a five (5) per cent increase forecast for the year. It was mainly due to lower operating capacity in the wood related sector - particularly the sawmills - which accounts for about 30% of the sales in this classification. The growth for the remaining customers, when adjusted for shifts between distribution and transmission loads, was just over three (3) percent.

FORECAST METHODOLOGY

The factors considered important in forecasting Industrial Distribution energy are (a) the state of the provincial economy as measured by the total real domestic provincial product or its goods producing and manufacturing sector components, (b) potential for conservation. The effects of these factors are discussed below.

(a) Effects of Economic Conditions

Growth in the real domestic provincial product is considered to be the key factor affecting industrial distribution electrical requirements. The electrical sales to other classifications are also dependent on economic conditions. Our ability to correlate past data (quarterly or yearly) on electrical sales and the real domestic provincial product is therefore limited by the fact that an unusual change in the real domestic provincial product, e.g. a drop caused by abnormal circumstances in the pulp and paper industry, may only affect electrical energy requirements of Industrial Transmission customers. However the long term trend in the growth rate for these two variables is expected to reflect the nature and magnitude of the effect of economic growth on Industrial Distribution electrical energy.

Annual actual data and percentage changes for Industrial Distribution sales and the real domestic provincial product are given in Table IX. The average annual compound growth rates are also compared.

The long term historical relationship between the real domestic provincial product and industrial distribution sales implies about three percent annual growth in sales if the long term growth in the real domestic provincial product is 2.2 percent annually[2]. Though this relationship, and the growth rate range based on it, is considered realistic for the long term its application in forecasting intervening years is not very useful as reasoned in the preceeding paragraphs.

TABLE IX

INDUSTRIAL DISTRIBUTION SALES AND REAL DOMESTIC PROVINCIAL PRODUCT RELATIONSHIP

Fiscal Year	Industrial Distribution Sales (GWH)	Annual Growth Rate	REAL DOMESTIC PROVINCIAL PRODUCT* (Millions of Dollars) Manufacturing Sector	Annual Growth Rate	Good Producing Sector	Annual Growth Rate	All Industries	Annual Growth Rate
1971-72	225		248		550		1614	
1972-73	241	7.1	285	15.1	576	4.7	1718	6.4
1973-74	251	4.1	319	11.6	655	13.7	1914	11.4
1974-75	268	6.8	348	9.2	728	11.2	1974	3.1
1975-76	295	10.1	311	-10.7	695	- 4.4	1995	1.1
1976-77	313	6.1	318	2.2	702	0.9	2058	3.2
1977-78	319	1.9	313	- 1.4	691	- 1.5	2057	0.0
1978-79	341	6.9	327	4.4	712	3.1	2135	3.8
1979-80	364	6.7	353	7.9	751	5.5	2204	3.2
1980-81	379	4.1	378	7.2	720	- 4.2	2196	-0.4
1981-82	353	-6.9	352**	-6.9	722**	0.0	2209**	0.6
Average Annual Growth Rate	4.6		3.6		2.8		3.2	
Ratio of Industrial Distribution Sales Growth to R.D.P.P. Growth			1.3		1.6		1.4	

* Source: (1) The Provincial Economies 1961-1980 Data; A supplement to the Quarterly Provincial Forecast by Conference Board of Canada.
(2) Quarterly Provincial Forecast, Conference Board of Canada, August 1982

** Conference Board Forecast.

(b) Conservation Potential

Recent research on potential for conservation in the industrial sector points to the potential for conservation through the use of energy efficient motors. Studies [3,4] undertaken by other utilities indicate that the high initial cost of "energy efficient" motors are now economically justifiable if evaluated on a life cycle cost basis. It is therefore likely to impact decisions for new or replacement motors.

Forecast Computations

The detailed annual forecast makes provision for the current slump in the wood related sector of the Industrial Distribution sales by assuming gradual recovery from the current (1982) estimates of 55% to 100% of the 1980 capacity by 1986. The growth for the remaining portion of the sales is forecast at 3.0% per year, based on judgemental downward adjustment, to allow for conservation effects, of historical growth rate trends and is in line with a long term growth rate of about 2.2 percent in the real domestic provincial product for New Brunswick.

The provincial forecast for electrical energy sales to the Industrial Distribution Classification was allocated to the NB Power portion and Wholesale for resale portion on the basis of historical data.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 3.3% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate in the first ten years of the previous (1981) Industrial Distribution forecast was 5.1 percent. The difference in the two growth rates is due to (i) significant loss of sales to the wood related sector which is only expected to gradually recover to 1980 levels by 1986 and (ii) the annual growth rate of 3% forecast for the remaining sectors is below the 5% overall rate used in the previous forecast.

The effect of lower sales to the wood related sector is such that the Industrial Distribution electrical energy requirements are forecast to be below the 1980/81 actual sales up to the fiscal year 1984/85. The results of this forecast are summarized in Table X.

TABLE X

FORECAST AND HISTORY OF INDUSTRIAL DISTRIBUTION (GWH)

			Breakdown of the Total Sales	
Fiscal Year		Total Sales New Brunswick	Wholesale For Resale	NB Power Portion
1971-72	Actual	225	36	189
1972-73		241	42	199
1973-74		251	46	205
1974-75		268	51	217
1975-76		295	57	238
1976-77		313	56	251
1977-78		319	58	255
1978-79		341	58	283
1979-80		364	58	305
1980-81		379	58	321
1981-82		353	60	293
1982-83	Forecast	348	58	290
1983-84		365	61	304
1984-85		382	64	318
1985-86		400	67	333
1986-87		414	69	345
1987-88		427	71	356
1988-89		443	74	369
1989-90		457	76	381
1990-91		473	79	394
1991-92		487	81	406
1992-93		502	84	418
1993-94		517	86	431
1994-95		533	89	444
1995-96		549	92	457
1996-97		565	94	471

FOOTNOTES

(1) Based on an analysis of the billing records for Industrial Distribution customers for the fiscal year 1980/81 and 1981/82.

(2) WONG, Hon-Po: General Service Forecast, 1982-2001, NB Power, pp. 9-20.

(3) "Energy Efficient Motors" by the Energy Conservation and Utilization Division, B.C. Hydro.

(4) "Canadian Energy Efficient Electric Motor Program" by the Energy Conservation Division, Ontario Hydro.

STREET LIGHTS CLASSIFICATION

The sales to the customers in this classification include energy sold to Commission owned street lights, customer owned facilities, off-street dusk to dawn facilities and other special services such as railway crossing signals. The Street Lights classification represents a very small proportion (just over one-half of one percent) of the total "in-province" sales by NB Power.

Between 1970 and 1977 the energy sales to this classification grew at an average annual rate of 8.7%. This growth rate has decelerated significantly during the last five years to less than three (3) percent per year.

FORECAST METHODOLOGY

Recent development of low wattage and high efficiency sodium lights and general conservation measures by municipalities are considered to be the principal reasons for the decline in the sales growth rate for this customer classification. The gradual switch to high efficiency street lights is expected to continue and therefore impact future growth rate of the energy needed for street lighting. The forecast for this classification was based on the trend over the last three years.

The total Street Lights energy sales for the province were allocated, on the basis of historical relationship, to the NB Power portion and the amount sold as Wholesale for resale.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 2.0% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate in the first ten years of the previous (1981) Street Lights forecast was 3.1 percent. The results of this forecast are summarized in Table XI.

TABLE XI

FORECAST AND HISTORY OF STREET LIGHTS SALES (GWH)

Fiscal Year		Total Sales New Brunswick	Breakdown of the Total Sales	
			Wholesale For Resale	NB Power Portion
1971-72	Actual	36	11	25
1972-73		39	12	27
1973-74		42	12	30
1974-75		46	11	35
1975-76		50	11	39
1976-77		53	11	42
1977-78		56	12	44
1978-79		57	10	47
1979-80		59	10	49
1980-81		61	11	50
1981-82		63	12	51
1982-83	Forecast	64	12	52
1983-84		66	13	53
1984-85		67	13	54
1985-86		68	13	55
1986-87		70	14	56
1987-88		71	14	57
1988-89		72	14	58
1988-90		73	14	59
1990-91		75	14	61
1991-92		77	15	62
1992-93		78	15	63
1993-94		79	15	64
1994-95		81	15	66
1995-96		83	16	67
1996-97		85	17	68

WHOLESALE (FOR RESALE) CLASSIFICATION

The cities of Saint John and Edmundston own and operate utilities for the purpose of retailing electricity to the Residential, General Service, Industrial Distribution and Street Lights classifications. The two utilities purchase electrical energy from NB Power at transmission voltages and distribute it to their retail customers.

FORECAST METHODOLOGY

The future electrical energy requirements for these two cities were estimated by preparing a total provincial forecast for each of the four customer classifications which are served by these cities and then allocating the portion retailed directly by NB Power and the Wholesale for resale portion.

The allocation factors for each classification are based on a five year average of the proportion of total New Brunswick sales that were retailed by NB Power and the municipal utilities. The factors are forecast to remain constant throughout the forecast period. Results of the allocation for each classification are shown in the previous four sections of this document.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 2.9% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate in the first ten years of the previous (1981) Wholesale forecast was 2.6 percent. Table XII shows the history and forecast for the total Wholesale classification and a breakdown into its four components.

TABLE XII

WHOLESALE FORECAST AND HISTORY (GWH)

			Breakdown** of Total Sales by Classification			
Fiscal Year		Total* Sales	Residential	General Service	Industrial Distribution	Street Lights
1971-72	Actual	373	149	167	46	11
1972-73		408	162	193	42	11
1973-74		450	178	216	46	11
1974-75		499	203	237	51	11
1975-76		562	243	268	57	12
1976-77		615	274	279	62	12
1977-78		633	252	260	58	12
1978-79		609	257	276	58	10
1979-80		624	254	290	58	10
1980-81		644	255	295	58	11
1981-82		659	263	306	60	12
1982-83	Forecast	686	282	310	58	12
1983-84		707	294	317	61	13
1984-85		726	302	323	64	13
1985-86		749	311	333	67	13
1986-87		769	319	342	69	14
1987-88		791	328	352	71	14
1988-89		812	336	362	74	14
1989-90		832	344	371	76	14
1990-91		854	351	381	79	14
1991-92		875	358	391	81	15
1992-93		896	366	401	84	15
1993-94		918	375	411	86	15
1994-95		940	383	421	89	15
1995-96		962	391	432	92	16
1996-97		986	400	443	94	17

* Total includes distribution losses incurred by the municipal utilities.

** Data for individual classifications also includes purchases made by Campbellton Electric Light Department directly from Hydro Quebec up to the fiscal year 1977/78. However this is not included in total sales which reflects NB Power Wholesale energy.

INDUSTRIAL TRANSMISSION CLASSIFICATION

This classification has about forty large industrial customers, each with its individual substation and supplied electrical energy at transmission voltages. The customers range in size from nearly one to one hundred megawatts of connected load. Industrial Transmission sales have grown at an average annual rate of 4.1 percent between the fiscal year 1971/72 and 1981/82.

FORECAST METHODOLOGY

The sales to this customer classification are divided into four components for the purpose of this forecast.

1) Firm Load: requirements of existing and known potential customers
2) Allowance for Development
3) Contract Sales
4) Interruptible Sales.

Firm Load

The electrical energy needs of existing customers were forecast on the basis of: (i) the existing contractual agreement of peak load between NB Power and the customer, (ii) historical load factors and energy consumption, (iii) customer expectations obtained through contacts with the senior management and/or technical experts at customer location (iv) expected impact of economic conditions on specific industries.

The incorporation of the expected impact of economic conditions on specific industries is a deviation from previous forecasting procedure which was based on the first three steps listed above. Additional analysis related to economic conditions was considered necessary in light of the below "normal" performance, primarily in the wood related industry during the past two years.

The present electrical consumption trends in the pulp and paper industry indicate a capacity utilization which is about 20% below historical and forecast levels. This translates into a reduction of some 400 gwh in the fiscal year 1982/83 - about 12% of the total industrial energy. The lower sales and capacity utilization reflect the poor markets faced by the industry as a result of the overall world economy. The economic recovery is expected to be gradual with the electrical energy requirements for the pulp and paper customers returning to "normal" by 1986. The recovery provides for a five (5) percent increase in overall plant utilization per year.

The remaining customers comprise primarily the mining, smelting, petroleum and chemical product industries and account for about 35% of the sales to this classification. Forecast for each of these customers was based on recent historical trend, with a provision for gradual recovery for those that are currently consuming less electricity than their historical average. Potential for load growth due to expansion and/or substitution is considered in the following section.

Allowance for Development

All electric utilities are frequently faced with unexpected requests for electrical service to supply a new or expanding industrial customer. The growth in NB Power's load as a result of Industrial development has averaged about 15 MW per year over the last ten years.

Most large industrial developments require from two (2) to five (5) years of planning to be in operation and therefore often provide the utility with some lead time. Generally one or more Provincial and/or Federal Government agencies are involved in the development phases of a new industrial customer. These agencies are usually concerned with financial, environmental and regulatory aspects of the industry. The governmental involvement often provides sufficient information related to the size and nature of planned operations and the degree of uncertainty related to the proposed industrial development. Periodic contact is maintained with relevant departments and agencies which include Federal Department of Regional Economic Expansion, New Brunswick Department of Commerce and Development and New Brunswick Department of Natural Resources. In most cases the potential customers contact NB Power directly for forecast of power rates and availability - thus providing information on the planned addition(s).

The growth due to development up to the fiscal year 1983/84 was based on the information related to additions/expansions that are in progress and considered to be almost certain. The longer term historical average of 15 MW per year was used as an allowance for development for the fiscal years 1985/86 to 1996/97. For the next five years this is further supported by available information related to potential new loads and subjective probabilities of success for these loads.

Contract Sales

This classification is based on a single customer - a cogeneration facility with MacMillan Rothesay Ltd. - for the sale of steam and electricity from NB Power's Courtenay Bay No. 2 Unit in Saint John. Contract sales in the last few years have been relatively steady between 70 and 80 GWH/year. The sales forecast of 50 GWH in each of the next two years reflects the expected impact of economic conditions on the pulp and paper industry. Forecast of 73 GWH/year from 1984/85 onwards is in line with historical data.

Interruptible Sales

Industrial Transmission customers can purchase interruptible power as a substitute to their own generating capacity.

The sales for this type of purchase have fluctuated widely in the past. Most fluctuations have resulted from market or labour related problems within the pulp and paper industry. Higher than normal river flows from time to time lead to availability of lower cost interruptible power and consequently larger sales for this classification.

This type of energy sale is made only when excess capacity is available and it does not have any direct bearing on NB Power's generation planning. The forecast for the next two fiscal years is for 200 GWH/year. Between 1984/85 and 1996/97 the interruptible energy is forecast at 250 GWH/year. Increased interruptible energy purchases indicated by existing customers account for 30 GWH of the forecast increase of 50 GWH by 1984/85. The remaining 20 GWH increase reflects a recovery of the current reduction in sales resulting from poor economic conditions.

FORECAST RESULTS

The results of this forecast are an average annual growth rate of 4.6% for the first ten years, i.e. the fiscal years 1981/82 to 1991/92. The annual growth rate in the first ten years of the previous (1981) Industrial Transmission forecast was 4.0 percent.

The higher growth rate in this forecast, particularly in the fiscal years 1983/84 and 1984/85, reflects, (i) gradual but ultimate recovery of the wood related industry and (ii) the effect of shift from chemical pulping to thermo mechanical pulping (a process which requires more KWH/ton of pulp) in the pulp and paper industry.

The history and forecast of total Industrial Transmission sales along with a breakdown into its four components is shown in Table XIII.

TABLE XIII

FORECAST AND HISTORY OF INDUSTRIAL TRANSMISSION SALES (GWH)

Fiscal Year		Total Sales	Breakdown of the Total Firm Load	Contract	Interruptible	Allowance for Development
1971-72	Actual	2176	1752	382	42	-
1972-73		2454	2005	388	61	-
1973-74		2509	2089	331	89	-
1974-75		2651	2232	320	99	-
1975-76		2381	2254	53	74	-
1976-77		2857	2666	75	116	-
1977-78		2978	2758	80	140	-
1978-79		3108	2872	68	168	-
1979-80		2853	2630	25	198	-
1980-81		3301	2933	75	293	-
1981-82		3248	2957	62	229	-
1982-83	Forecast	2957	2707	50	200	-
1983-84		3450	3200	50	200	-
1984-85		4088	3660	73	250	105
1985-86		4341	3808	73	250	210
1986-87		4581	3943	73	250	315
1987-88		4686	3943	73	250	420
1988-89		4791	3943	73	250	525
1989-90		4896	3943	73	250	630
1990-91		5001	3943	73	250	735
1991-92		5106	3943	73	250	840
1992-93		5212	3943	73	250	945
1993-94		5317	3943	73	250	1051
1994-95		5422	3943	73	250	1156
1995-96		5527	3943	73	250	1261
1996-97		5632	3943	73	250	1366

"IN-PROVINCE SYSTEM NET ENERY FORECAST

The total "in-province" energy forecast - generally referred to as System Net - includes sales to all six customer classifications within the Province of New Brunswick together with the associated distribution and transmission losses. The System Net energy does not include export sales or the energy used for station service at our generating plants. The distribution losses are forecast at 5.7% of the sales at distribution voltages and the transmission losses which relate to the total "in-province" supply are forecast at 7.0%. These losses are forecast on the basis of recent system performance.

The yearly forecast of energy for each classification - and the corresponding actuals for the past three years - are shown in Tables XIV(a) and XIV(b). The amount of distribution and transmission losses are also shown.

TABLE XIV (a)

LOAD FORECAST (GWH)
FISCAL YEAR ENDING MARCH 31

CLASSIFICATION	1979-80 ACTUAL	1980-81 ACTUAL	1981-82 ACTUAL	1982-83 OUTLOOK	1983-84	1984-85	1985-86	1986-87	1987-88
1. RESIDENTIAL	1,975	2,057	2,119	2,213	2,305	2,373	2,440	2,507	2,572
PERCENTAGE INCREASE	-	4.1	3.0	4.5	4.1	2.9	2.8	2.7	2.6
2. GENERAL SERVICE	1,118	1,165	1,169	1,188	1,213	1,236	1,275	1,311	1,347
	-	4.2	.4	1.7	2.1	1.9	3.1	2.8	2.8
3. STREET LIGHTS	49	50	51	52	53	54	55	56	57
	-	2.2	1.6	2.0	2.0	2.0	2.0	2.0	2.0
4. INDUSTRIAL DISTRIBUTION	305	320	293	290	304	318	333	345	356
	-	5.0	-8.5	-.6	4.8	4.6	4.7	3.4	3.4
5. TOTAL DISTRIBUTION SALES	3,448	3,593	3,632	3,746	3,877	3,983	4,104	4,220	4,334
	-	4.2	1.1	3.1	3.5	2.7	3.1	2.8	2.7
6. DISTRIBUTION LOSSES	217	202	241	213	220	227	233	240	246
7. TOTAL DISTRIBUTION SUPPLY	3,666	3,795	3,873	3,959	4,098	4,210	4,338	4,460	4,580
	-	3.5	2.0	1.9	3.5	2.7	3.1	2.8	2.7
8. WHOLESALE TRANSMISSION	627	639	659	686	707	726	749	769	791
	-	1.9	3.0	4.1	3.1	2.7	3.2	2.7	2.9
9. TOTAL VARIABLE SUPPLY	4,293	4,435	4,532	4,640	4,802	4,933	5,085	5,226	5,367
	-	3.3	2.2	2.4	3.5	2.7	3.1	2.8	2.7
10. INDUSTRIAL-FIRM	2,630	2,933	2,957	2,707	3,200	3,660	3,808	3,943	3,943
- ALLOWANCE FOR DEVELOPMENT	0	0	0	0	0	105	210	315	420
- CONTRACT	25	74	62	50	50	73	73	73	73
- INTERRUPTIBLE	198	293	229	200	200	250	250	250	250
- TOTAL	2,853	3,301	3,248	2,957	3,450	4,088	4,341	4,581	4,686
	-	15.7	-1.5	-8.9	16.7	18.5	6.2	5.5	2.3
11. TOTAL IN-PROVINCE SUPPLY	7,147	7,736	7,780	7,597	8,252	9,021	9,426	9,807	10,053
	-	8.2	.6	-2.6	8.6	9.3	4.5	4.1	2.5
12. TRANSMISSION LOSSES	484	524	595	540	577	632	660	687	704
13. SYSTEM NET	7,632	8,260	8,375	8,137	8,829	9,653	10,086	10,494	10,757
	-	8.2	1.4	-2.8	8.5	9.3	4.5	4.0	2.5

TABLE XIV (b)

LOAD FORECAST (GWH)
FISCAL YEAR ENDING MARCH 31

CLASSIFICATION	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
1. RESIDENTIAL	2,635	2,694	2,754	2,814	2,876	2,941	3,006	3,073	3,142
PERCENTAGE INCREASE	2.5	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2
2. GENERAL SERVICE	1,385	1,421	1,459	1,499	1,536	1,575	1,614	1,654	1,696
	2.8	2.6	2.7	2.7	2.5	2.5	2.5	2.5	2.5
3. STREET LIGHTS	58	59	61	62	63	64	66	67	68
	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
4. INDUSTRIAL DISTRIBUTION	369	381	394	406	418	431	444	457	471
	3.4	3.4	3.4	3.0	3.0	3.0	3.0	3.0	3.0
5. TOTAL DISTRIBUTION SALES	4,449	4,557	4,670	4,782	4,895	5,012	5,131	5,253	5,378
	2.6	2.4	2.5	2.4	2.4	2.4	2.4	2.4	2.4
6. DISTRIBUTION LOSSES	253	259	265	271	278	285	292	299	306
7. TOTAL DISTRIBUTION SUPPLY	4,700	4,814	4,933	5,051	5,170	5,295	5,422	5,550	5,682
	2.6	2.4	2.5	2.4	2.4	2.4	2.4	2.4	2.4
8. WHOLESALE TRANSMISSION	812	832	854	875	896	918	940	962	986
	2.7	2.5	2.6	2.5	2.4	2.5	2.4	2.3	2.5
9. TOTAL VARIABLE SUPPLY	5,511	5,645	5,786	5,926	6,066	6,212	6,361	6,510	6,667
	2.6	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4
10. INDUSTRIAL-FIRM	3,943	3,943	3,943	3,943	3,943	3,943	3,943	3,943	3,943
- ALLOWANCE FOR DEVELOPMENT	525	630	735	840	946	1,051	1,156	1,261	1,366
- CONTRACT	73	73	73	73	73	73	73	73	73
- INTERRUPTIBLE	250	250	250	250	250	250	250	250	250
- TOTAL	4,791	4,896	5,001	5,106	5,212	5,317	5,422	5,527	5,632
	2.2	2.2	2.1	2.1	2.1	2.0	2.0	1.9	1.9
11. TOTAL IN-PROVINCE SUPPLY	10,302	10,541	10,787	11,032	11,278	11,529	11,783	12,037	12,299
	2.5	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2
12. TRANSMISSION LOSSES	721	738	756	772	789	808	825	843	861
13. SYSTEM NET	11,023	11,279	11,543	11,804	12,067	12,337	12,608	12,880	13,160
	2.5	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2

MONTHLY BREAKDOWN OF THE FORECAST

In order for the load forecast to be used effectively in the overall utility planning process it is necessary to further breakdown the annual energy forecast into monthly values and to determine the peak hourly demand associated with each month's energy sales. The procedure for allocating annual energy over the twelve months and converting it into peak demand is outlined below.

MONTHLY ENERGY

In an effort to improve the monthly breakdown of the annual energy the procedure used in this forecast is somewhat different and more detailed than that used in previous years. The total energy for each customer classification was apportioned into twelve calendar months based on its normalized historical pattern and expected changes in future trends. This is in contrast to the previous forecast procedures where total annual energy was divided into two major groups, Variable and Industrial Transmission, and their energy broken down by month on the basis of historical pattern.

Residential breakdown incorporates weather adjusted historical data and the future expectations related to space heating related increases. The monthly pattern for energy sales to this classification therefore changes over the forecast period.

Historical weather adjusted sales for General Service classification show a uniform pattern. The effect of space heating related load in the coming years is expected to be minimal, especially after natural gas effects are felt by 1984/85, and therefore the annual forecast has been apportioned to calendar months on the basis of weather normalized historical data.

Breakdown for Industrial Distribution and Street Lighting energy is also based on past data. However any data considered abnormal due to unusual conditions was excluded in determining historical pattern.

Monthly breakdown of Industrial Transmission energy incorporated the past trends for its main components i.e., firm, interruptible and contract loads. Projected schedules of new major additional loads were also considered in arriving at monthly energy for this customer classification.

The total in-province monthly energy inclusive of transmission and distribution losses is shown in Table XV.

PEAK HOURLY DEMAND

The timing of new facilities depends to a large degree on the forecast of peak hourly demand for the system. The most significant factor in the determination of the peak hourly demand for any period is the corresponding load factor. Unlike previous forecast which were based on an analysis of the annual load factor, this forecast is based on an analysis of load factors for each month.

Load factors for the Variable components of the total in-province energy were determined and analyzed for the fiscal years 1971/72 to 1981/82. This historical data was used in projecting future variable load factor and the corresponding peak demand .

Load factor projection for the Industrial Transmission component of the total energy was based on individual customer analysis up to the fiscal year 1986/87 and kept constant at 83.2% beyond this point for the firm portion of the load. The allowance for industrial development was included at 80% load factor.

TABLE XV

IN-PROVINCE ENERGY (GWH) FORECAST

Fiscal Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Annual Total
1982-83	676	611	566	559	564	571	644	718	811	850	788	779	8137
1983-84	700	631	579	600	609	618	708	798	902	945	871	867	8829
1984-85	802	730	680	674	681	685	770	847	948	993	923	918	9653
1985-86	839	764	711	705	712	715	805	884	990	1037	964	959	10086
1986-87	873	796	740	735	741	744	837	920	1029	1079	1002	998	10494
1987-88	896	816	757	751	759	761	857	943	1056	1108	1029	1024	10757
1988-89	918	836	774	769	776	779	878	966	1082	1138	1056	1051	11023
1989-90	940	855	791	786	793	796	897	988	1109	1166	1082	1076	11279
1990-91	962	875	808	803	811	813	918	1011	1135	1195	1109	1102	11543
1991-92	984	895	825	820	828	831	938	1034	1162	1223	1135	1128	11804
1992-93	1007	915	842	837	846	848	958	1057	1188	1252	1161	1154	12067
1993-94	1030	935	860	855	864	866	979	1081	1216	1282	1189	1181	12337
1994-95	1052	956	878	873	882	885	1000	1105	1243	1311	1216	1207	12608
1995-96	1075	977	895	891	900	903	1021	1128	1271	1341	1244	1234	12880
1996-97	1099	998	914	910	919	922	1042	1153	1299	1371	1271	1261	13160

The non-coincident peak demand obtained by adding Variable and Industrial components was adjusted for diversity, to determine the instantaneous coincident peak demand. Further adjustment for transmission losses and conversion from instantaneous to hourly load were made to determine the peak hourly demand.

The peak hourly demand for the years 1982/83 to 1985/86 was not adjusted for the possible effects of industrial shutdowns expected especially in the pulp and paper sector. This may result in the demand forecast in some months being higher than actual. The usefulness of any refinement in the peak demand is offset by the possibility that Industrial closures may not concide with the peak demand and therefore render any adjustment worthless.

The monthly energy breakdown and the peak hourly demand were derived by using specially developed computer programs. Peak hourly demands for each month of the forecast period are shown in Table XVI.

TABLE XVI

IN-PROVINCE PEAK HOURLY DEMAND (MW)

Fiscal Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.(1)	Feb.	March
1982-83	1290	1212	1102	1055	1085	1120	1205	1375	1521	1579	1494	1419
1983-84	1323	1240	1121	1108	1145	1187	1316	1497	1651	1715	1623	1545
1984-85	1449	1363	1236	1187	1219	1256	1350	1537	1698	1765	1670	1589
1985-86	1492	1402	1269	1218	1252	1290	1387	1582	1750	1821	1723	1638
1986-87	1534	1440	1299	1249	1283	1321	1423	1624	1799	1875	1772	1685
1987-88	1575	1477	1330	1279	1314	1354	1458	1667	1848	1929	1822	1731
1988-89	1617	1515	1362	1309	1346	1386	1495	1710	1897	1982	1872	1778
1989-90	1656	1552	1392	1339	1377	1417	1529	1751	1944	2033	1920	1823
1990-91	1697	1589	1424	1370	1409	1450	1566	1793	1993	2085	1969	1868
1991-92	1738	1626	1455	1401	1441	1482	1601	1835	2041	2137	2017	1914
1992-93	1779	1664	1487	1431	1473	1515	1637	1878	2089	2189	2066	1959
1993-94	1821	1702	1519	1463	1505	1548	1674	1921	2139	2243	2117	2007
1994-95	1863	1742	1552	1495	1539	1582	1712	1965	2189	2296	2166	2054
1995-96	1906	1781	1585	1527	1572	1616	1749	2009	2239	2351	2217	2101
1996-97	1949	1821	1619	1561	1607	1652	1788	2055	2291	2405	2269	2150

(1) Represents fiscal year peak demand.

APPENDIX A

POPULATION

Forecast of electrical energy consumption is largely dependent on the changes in population. Increase in population leads to a larger number of households, together with more commercial activity, such as a need for more schools and hospitals, thereby causing a greater demand for electrical energy. Future population levels are dependent on three factors: births, deaths and migration.

Births are a function of fertility rates and female population in the child bearing age. Fertility rates fluctuate with socio-economic conditions and are difficult to forecast. Table I shows the trend of actual fertility rates in the past and compares these with the four projections made by Statistics Canada after the 1976 census.

Deaths are a function of mortality rates applied to the various age groups within the population. As shown in Table II the past actual mortality rates are relatively stable and also quite close to the levels projected by Statistics Canada.

Migration patterns, which are generally considered to be dependent on economic conditions, are perhaps the hardest to forecast. Past data indicates that migration has followed cyclical patterns. Estimates based on census data indicate average net in migration of about 2,000 people per year between 1971 and 1976 and average net out migration of about 2,000 people per year between 1976 and 1981.

Population forecast is thus dependent on the accuracy of the projections for each of the above variables. For the purpose of forecasting regular residential customers - a key element of residential electrical energy consumption - the uncertainty of future fertility rates is eliminated by basing our fifteen year forecast on population over fifteen years of age (those likely to form the head of a household). Births between now and the end of the forecast period do not increase the portion of population over fifteen years of age. This leaves deaths and migration as the only uncertainties. For other uses, e.g., commercial sector growth which includes schools and hospitals, we need a forecast of the total population.

The overall actual fertility rate since 1976 and for each of the past five years has been less than the Statistics Canada projections based on 1976 census (see Table I). The fertility rates since 1976 also show a downward trend, i.e. the rate in each of the years is less than that in the immediately preceeding year. The population projection in this forecast is based on a somewhat further reduction in the fertility rates for New Brunswick.

Mortality rate projections, as shown in Table II, are based on survival rate estimates for each age group. The higher mortality rate during the forecast period as compared to the history reflects the aging population, i.e. larger number of people in the upper age groups.

The population projection assumes that migration into the province will match the migration out of the province. This zero net migration assumption is based on consultation with Economics and Statistics Branch of the Province of New Brunswick and is also consistent with recent indications on reversal in westward migration.

The fertility rate, mortality (survival) rate and migration assumptions were applied to the base population for each age level through a specially developed computer program. This provided the total population projection and that for each age group. The history and projection of total population and that over the age of fifteen is shown in Table III and compared to the corresponding results from the previous (1981) forecast.

TABLE I

FERTILITY RATES*

		Statistics Canada Projections(2)			
Year	Actual	# 1	# 2	# 3	# 4
1976	7.2	6.9	6.9	6.9	6.9
1977	7.0	6.8	6.8	6.6	6.6
1978	6.5	6.9	6.9	6.5	6.5
1979	6.2	6.9	6.9	6.4	6.4
1980	6.1	7.0	7.0	6.4	6.4
1981	6.0	7.0	7.0	6.3	6.3
	Projection(1)				
1985	5.8	7.0	7.1	6.2	6.2
1990	5.3	6.7	6.7	5.7	5.7
1995	4.9	6.0	6.0	5.1	5.1

* Births per year per 100 of female population between the ages of 15 to 49.
Source: (1) Economics and Statistics Branch, Department of Finance, Province of New Brunswick.
(2) Population Projections for Canada and the Provinces, S.C. Cat. No. 91-514.

TABLE II

MORTALITY RATES*

		Statistics Canada Projections(2)			
Year	Actual	# 1	# 2	# 3	# 4
1976	7.7	8.0	8.0	8.0	8.0
1977	7.5	7.9	7.9	7.9	7.9
1978	7.6	7.9	7.9	7.9	7.9
1979	7.3	7.8	7.8	7.8	7.8
1980	7.5	7.9	7.8	7.9	7.8
1981	7.5	7.9	7.9	7.9	7.9
	Projection(1)				
1985	8.0	8.0	7.8	7.8	7.7
1990	8.5	8.3	8.0	8.2	7.9
1995	8.9	8.6	8.3	8.6	8.2

* Deaths per year per 1000 of total population.
Source: (1) Economics and Statistics Branch, Department of Finance, Province of New Brunswick.
(2) Population Projection for Canada and the Provinces, S.C. Cat. No. 91-514.

TABLE III

POPULATION PROJECTIONS

YEAR*	TOTAL POPULATION		POPULATION OVER AGE 15		
	1981 Forecast	1982 Forecast	1981 Forecast	1982 Forecast	
1976	680,500	679,600	488,200	487,600	
1977	691,000	685,800	500,400	496,600	
1978	697,500	690,200	511,800	505,100	
1979	702,900	693,800	521,700	513,100	
1980	709,400	696,300	530,400	519,700	ESTIMATES[1]
1981	716,300	698,300	538,900	525,400	
1982	722,700	703,700	546,000	532,900	PROJECTIONS
1983	729,200	709,200	552,600	539,800	
1984	735,800	714,600	558,800	546,400	
1985	742,200	719,900	565,300	553,100	
1986	748,600	725,100	571,700	559,900	
1987	754,800	730,000	577,900	566,300	
1988	760,700	734,800	583,400	572,100	
1989	766,500	739,300	588,600	577,400	
1990	772,100	743,600	593,800	582,800	
1991	777,300	747,800	598,900	587,800	
1992	782,200	751,700	603,700	592,400	
1993	786,900	755,400	608,800	596,500	
1994	791,400	758,900	613,900	600,300	
1995	-	762,200	-	604,100	
1996	-	765,300	-	607,700	

* The values are as of October 1 for each year, the mid point of NB Power fiscal year.

(1)Preliminary Intercensal Estimates of the Population by Sex and Age, Canada and Provinces, June 1st 1977 to 1981, Statistics Canada, 1982.

HEADSHIP RATE PROJECTION

Headship rate is defined as the number or proportion of household heads in a given population group. In this forecast it is the proportion of regular residential customers among the population over fifteen years of age. The use of headship rate in determining future housing stock is a widely accepted technique and is used by agencies such as Statistics Canada.

The Statistics Canada estimate for the headship rate in New Brunswick, based on 1976 census[1], was below the NB Power estimate. Also Statistics Canada estimates are only available for five year intervals. For these reasons we have determined the historical headship rate in New Brunswick by using NB Power estimates of regular residential customers and Statistics Canada estimates of population over the age of fifteen (Table I).

Historical trend for headship rate shows a steady increase since 1971. This change can be attributed to several factors including: greater proportion of single person households, increases in divorce rates and increases in household formation by the younger age groups.

Headship rate in this forecast is projected by fitting a least squares logarithmic curve through historical data. The results of the least squares fit are shown in Table II.

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[1] Household, and Family Projections for Canada, Provinces and the Territories 1976 to 2001: Statistics Canada Catalogue No. 91-22.

TABLE I

HISTORICAL HEADSHIP RATE ESTIMATES

Fiscal Year	NB Power Estimate	Statistics Canada* Estimate(1)
1971-72	37.556	36.5
1972-73	38.505	
1973-74	39.629	
1974-75	40.648	
1975-76	40.905	
1976-77	41.647	39.3
1977-78	42.141	
1978-79	42.452	
1979-80	42.549	
1980-81	42.684	
1981-82	42.696	40.9

* Statistics Canada estimates do not correspond exactly with NB Power fiscal year.

(1) Source: Household and Family Projections. Canada, Provinces and Territories 1976-2001, Cat. 91-522.

TABLE II

HEADSHIP RATE PROJECTIONS

Fiscal Year	Headship Rate (1)
1982/83	42.799
1983/84	42.900
1984/85	42.942
1985/86	42.979
1986/87	43.013
1987/88	43.043
1988/89	43.072
1989/90	43.098
1990/91	43.122
1991/92	43.145

(1) Based on logarithmic least squares fit.

r^2 = 0.98

a = 42.167

b = 0.353

APPENDIX C

HIGHLIGHTS OF THE 1981 APPLIANCE SATURATION SURVEY

The principal findings of the 1981 Survey which were an input into this load forecast are summarized below. Detailed data is in a separate document titled 1981 Appliance Saturation Survey.

1. The electrical appliance saturation levels (except B & W television and plug in space heaters), within the households surveyed, have increased in comparison to the 1979 results. The increases are in line with historical patterns and projections.

2. Electricity as a principal space heating source has grown from 22.8% in 1979 to 23.9% in 1981. Another 9.3% of the residential customers indicated the use of electricity as a supplementary heating source in the 1981 survey. The corresponding percentage from the 1979 survey is 9.0%.

3. Utilization of wood as a principal space heating fuel continues to increase. The 19.7% saturation level as principal space heating fuel compares to 12.2% in 1979. The survey results indicate that 43.6% of the electric heated homes and 22.2% of the oil heated homes use wood as a supplementary space heating fuel.

4. Electric water heater saturation level has increased from 64.8% in 1979 to 66.1% in 1981.

5. In response to the question on planned changes in the principal space heating system, 68.4% indicated no plans to change, 13.1% plan a change within five years and 18.3% did not know when they would change. The corresponding responses of oil space heating customers were: 54.2% do not plan a change, 18.7% plan a change within five years and 27.1% did not know when they would change their heating system.

6. Of those planning a change in heating system about 40% indicated the use of electricity by itself or in combination with other fuels. Over 50% of respondents indicated their preference for wood or its combination with another fuel. Natural gas, solar, oil, their combination with each other or other heating sources were the other choices indicated by respondents.

7. Cost consideration was given as the principal reason for planned change of heating fuel by 63% of respondents while need for replacement (12.9%) and federal government grant for off-oil conversions (8.6%) were given as other main reasons.

8. Electricity by itself or in combination with wood or another fuel would be the choice of over one half of the respondents if they were to build a new home today.

OFF OIL CONVERSIONS

Between October 28, 1980 (the effective date for the federal government Canada Oil Substitution Program) and September 1982 about 5,000[1] residential customers in New Brunswick switched from oil to electricity as their principal space heating source. Some 5,000 have converted from oil to wood and about 100 to propane over the same period.[2]

The off-oil conversions are a consequence of many factors[3], the most significant of which are:

(1) cost considerations;
(2) federal government grant of $800 as a part of the Canada Oil Substitution Program.

The November 1981 Appliance Saturation Survey results indicate that 55.4% of the residential customers in the province use oil as their principal space heating fuel. Based on NB Power estimate of 224,000 regular residential customers in the province, this translates into about 124,000 oil heated residential units in New Brunswick.

Customer intentions related to a change of their present space heating system, as determined by a question in the 1981 Appliance Saturation Survey, are summarized below.

	Oil Heated Residential Customers	All Residential Customers
No plans to change	54.2	68.4
Plans to change within five years	18.7	13.1
Do not know/No response	27.1	18.5

The customers who responded 'do not know' or those that did not respond are considered to have same intentions as the customers with a definite response. On this basis 25.7% of the oil heated customers plan to change their heating system within the next five years.

In response to a further question on the fuel for planned new heating system about 40% indicated a preference for electricity by itself or in combination with another fuel. The remainder indicated preference for wood, natural gas, propane, solar heating or some combination of these energy sources as their choice. The net effect of these findings is that some 10.3% of oil heated customers in the province indicated their intention to change to electricity as a heating source within the next five years. This represents an annual rate of some 2%.

These survey results were used to provide the basis estimating the number of conversions in this forecast. On average this means some 2600 conversions per year. The conversions forecast for the current fiscal year (1982/83) is 3,700, which is in line with the trend during the first five months of the fiscal year. This higher than average forecast conversion rate is felt to be related to the effect of no increase in NB Power rates in 1982.

The conversion from oil to electric space heating is also forecast to result in a simultaneous conversion to electricity for domestic water heating. However 52.8% of the oil space heated residential customers on the NB Power system already have an electric hot water heater and are thus not vulnerable. The remaining 47.2% customers are forecast to convert to electric hot water when they switch from oil to electric space heating. On an average this means there will be some 1,250 conversion from oil to electric water heating.

With the expected availability of natural gas in some areas of New Brunswick, many oil space heating homes with electric water heaters are expected to switch to natural gas. This would result in a loss of existing electric water heaters and the related load. Estimates of the number of water heaters converting from electricity to natural gas are based on the data collected for a study on natural gas distribution.[4] On an average 500 electric water heaters per year will be lost due to conversion to natural gas. The net effect is a forecast of an average annual increase of 750 electric water heaters due to conversions.

The net change in the number of electric space and water heating customers due to conversion is shown in Table I. These conversion estimates have been incorporated in the Residential forecast model.

TABLE I

RESIDENTIAL SPACE AND WATER HEATING CONVERSIONS*

FISCAL YEAR	NUMBER OF SPACE HEATING CONVERSIONS	NUMBER OF WATER HEATING CONVERSIONS OIL TO ELECTRIC	ELECTRIC TO N. GAS	NET CHANGE
1982/83	3700	1750	-	1750
1983/84	2800	1300	-	1300
1984/85	2500	1200	(100)	1100
1985/86	2500	1200	(300)	900
1986/87	2500	1200	(500)	700
1987/88	2500	1200	(650)	550
1988/89	2500	1200	(750)	450
1989/90	2500	1200	(850)	350
1990/91	2500	1200	(950)	250
1991/92	2500	1200	(1050)	150
Total	26,500	12,650	(5150)	7,500

* All of the conversion numbers have been rounded to the nearest fifty.

FOOTNOTES

(1) Conversion data based on applications for federal government grant processed by NB Power and three municipal utilities in New Brunswick.

(2) Based on conversion data compiled by Energy Mines and Resources office in Dieppe, New Brunswick and Ottawa, Ontario.

(3) NB Power 1981 Appliance Saturation Survey pg. 15.

(4) Based on the data collected for, 'Study on Natural Gas Distribution' in the Province of New Brunswick, Crandall Energy Consultants Ltd.